12-30-04

AF/1725 $

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)
	) Group Art Unit 1725
Joseph R. Ward	)
	) Examiner: Kevin P. Kems
Serial No.: 10/027,071	)
	) Our Case No. D-5216
Filed: December 20, 2001	)
	)
For: IMPROVED METHOD FOR THE MANUFACTURE OF GRAY CAST IRON FOR CRANK CASES AND CYLINDER HEADS	)

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APPELLANT'S BRIEF (37 C.F.R. § 41.37)

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This brief is filed in response to the Final Action mailed August 12, 2004, and the rejections therein, and pursuant to the Notice of Appeal filed October 27, 2004, in the above-identified application.

The fee is included on the attached fee transmittal form.

Appellant respectfully submits and requests consideration of the following appeal brief. The Claims Appendix, submitted pursuant to 37 C.F.R. § 41.37(c)(1)(viii), is at Tab 4, and the Evidence Appendix, submitted pursuant to 37 C.F.R. § 41.37(c)(1)(ix), is at Tab 1.

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I. REAL PARTY IN INTEREST (37 C.F.R. § 41.37(c)(1)(i))

The real parties in interest in this appeal are the International Truck and Engine Corporation and its wholly-owned subsidiaries, Indianapolis Casting Corporation and International Engine Intellectual Property Company, LLC.

II. RELATED APPEALS AND INTERFERENCES (37 C.F.R. § 41.37(c)(1)(ii))

With respect to other appeals and interferences that will directly affect, or be directly affected by, or having a bearing on the Board's decision in this appeal, there are no such appeals or interferences.

III. STATUS OF CLAIMS (37 C.F.R. § 41.37(c)(1)(iii))

A. Total Number of Claims in Application: 17
The claims remaining in the application are: 1-5 and 9-17.

B. Status of All The Claims:
1. Claims cancelled: 6-8
2. Claims withdrawn from consideration, but not cancelled: None
3. Claims pending: 1-5 and 9-17
4. Claims allowed: none
5. Claims rejected: 1-5 and 9-17

C. Claims on Appeal:
The claims on appeal are: 1-5 and 9-17.

IV. STATUS OF AMENDMENTS (37 C.F.R. § 41.37(c)(1)(iv))

No amendment is pending in this application.

V. SUMMARY OF CLAIMED SUBJECT MATTER (37 C.F.R. § 41.37(c)(1)(v))

The invention provides an economical method for manufacturing of gray cast iron crank cases and cylinder heads, having minimal iron carbide hard spots and chills upon solidification, and a minimal need for stress relief heat treatment of the finished casting. The method of the invention requires no additional processing equipment, and has the advantage of a short cooling time, that is, a hot shake-out temperature.

In a method of the invention for the manufacture of crank cases and cylinder heads from gray cast iron, a molten gray iron metal is first provided that has a carbon equivalent of about

4.05%, comprised of about 3.4% to about 3.45% carbon, and about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, while maintaining sulfur of the molten gray iron metal at about 0.05% to about 0.07%, manganese at about 1.7 times the percentage of the sulfur plus about 0.30% to about 0.40%, and base iron chromium of less than about 0.10%. The molten gray iron base metal is then transferred to a pouring ladle, and in the pouring ladle, the molten gray iron metal is alloyed with tin to a total tin content of about 0.05% to about 0.10%, to provide a molten, tin-alloyed, gray iron metal. The molten, tin-alloyed, gray iron metal is inoculated with a silicon-based inoculate to provide a further silicon addition of from about 0.10% to about 0.12%, and the resulting inoculated, molten, tin-alloyed, gray iron metal is poured from the ladle into the casting molds as soon as possible, and preferably no later than 7-10 minutes after its inoculation.

In this method of manufacture, the gray iron castings have, compared with prior manufacturing methods, substantially increased carbon levels, lower levels of phosphorus, significantly lower levels of chromium, somewhat lower levels of sulfur, and, with the alloying use of tin as a pearlite stabilizer, substantially reduces the potential for iron carbide hard spots and chills, and allows significantly reduced silicon content in the gray iron and minimal inoculant additions. Further, the high shake-out temperatures for the resulting castings also minimizes the need for alloy addition and provides castings with lower residual stresses.

The method of manufacture of this invention results in castings much stronger that would be anticipated by its chemical composition, with charge material inoculation and alloying costs lower than conventional practice while minimizing the need for heat stress relief heat treatment of the resulting castings.

The invention thus provides a substantial and non-obvious step forward in the manufacture of gray cast iron crankcases and cylinder heads.

The claims on appeal, which are attached at Tab 4, read on the specification and drawings as follows:

1. A method for the manufacture of crank cases and cylinder heads from grey cast iron comprising the steps of:	"This invention relates to casting methods using gray cast iron, and more particularly to casting methods for the manufacture of crank cases and cylinder heads with gray cast iron." Pg. 1, ll. 6-7. "A method of the invention for the manufacture of crank cases and cylinder heads from gray cast iron includes the steps of . . . " Pg. 2, ll. 10-11.

providing a molten controlled-content grey iron metal having a carbon equivalent of about 4.05%, comprised of about 3.40% to about 3.45% carbon, about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, while maintaining base iron sulfur at about 0.05% to about 0.07%, manganese at about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium less than about 0.10%	" . . . providing a molten gray iron metal having a carbon equivalent of about 4.05%, comprised of about 3.4% to about 3.45% carbon, and about 1.80% to about 1.90% silicon with less than 0.03% phosphorus, while maintaining sulfur of the molten gray iron metal at about 0.05% to about 0.07%, manganese at about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium of less than about 0.10%." Pg. 2, ll. 11-16. "As illustrated in FIG. 1, the first step in the method of the invention is preparing a molten gray iron base metal having a controlled content. The molten gray iron metal is prepared in an electric furnace from scrap steel, gray iron ingots, and gray iron scrap recovered from the manufacturing process. The content of the molten gray iron metal is controlled by making spectrographic analyses of the scrap steel, the gray iron ingots and recovered gray iron scrap, adjusting the relative amounts of each of these three ingredients and, to the extent necessary, and supplementing the molten gray iron by the addition of one or more of silicon, phosphorus, manganese and chromium, as needed." Pg. 3, ll. 10-17. See FIG. 1, first step.
transferring said molten controlled-content grey iron metal to a pouring ladle	"The molten gray iron base metal is transferred to a pouring ladle . . ." Pg. 2, line 16. "In the second step, the controlled-content, molten gray iron metal is placed in a pouring ladle for further processing." Pg. 3, ll. 20-21. See FIG. 1, second step.
alloying said molten controlled-content grey iron metal with tin in said pouring ladle to a total tin content of about 0.05% to about 0.10% to provide a molten tin-alloyed, controlled content grey iron metal	" . . . in the pouring ladle, the molten gray iron metal is alloyed with tin to a total of about 0.05% to about 0.10% . . ." Pg. 2, ll. 16-18. "And in the third step, the controlled content molten gray iron metal is alloyed in the pouring ladle with tin, to a total tin content of about 0.05% to about 0.10% . . ." Pg. 3, ll. 21-22. See FIG. 1, third step.
inoculating said molten tin-alloyed,	"The molten tin-alloyed gray iron metal is

controlled-content grey iron metal with a grey iron inoculant to a further silicon addition of from about 0.10% to about 0.12%	inoculated with the silicon-based inoculate to provide a further silicon addition of from about 0.10% to about 0.12% . . ." Pg. 2, ll. 18-20. "In the fourth step of the method, the tin alloyed molten gray metal is inoculated with a silicon-based inoculant(s) [sic], to a silicon addition of between about 0.10% to about 0.12%. Silicon-based inoculants with barium and/or calcium are preferred in the practice of this invention." Pg. 3, ll. 34-36. See FIG. 1, fourth step.
pouring said molten, tin-alloyed, inoculated controlled-content grey iron metal as soon as possible after said inoculation into a casting mold	" . . . the resulting inoculated molten-tin-alloyed gray iron metal is poured from the ladle into casting molds as soon as possible ..." Pg. 2, ll. 20-21. "Parts are then cast as soon as possible, and preferably less than 7-10 minutes, after inoculation of tin-alloyed molten gray iron metal ..." Pg. 3, line 36-Pg. 4, line 2. See FIG. 1, fifth step.
shaking the resulting casting out of the casting mold while at a temperature of over 1400°F	"The method of the invention ... has the advantage of short cooling time, that is, a hot shake-out temperature." Pg. 2, ll. 7-9. "Further, the hot shake-out temperatures for the resulting castings also minimizes the need for alloy addition and provides castings with lower residual stresses." Pg. 2, ll. 28-29. "The cast parts are removed from the mold while they are at a temperature of over 1400°F ..." Pg. 4, ll. 4-5.
2. The method of claim 1 wherein the step of providing the molten controlled content grey iron metal comprises determining the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of scrap steel, grey iron ingots and recovered grey iron scrap	"The molten gray iron metal is prepared in an electric furnace from scrap steel, gray iron ingots, and gray scrap iron recovered from the manufacturing process. The content of the molten gray iron metal is controlled by making spectrographic analyses of the scrap steel, gray iron ingots and recovered gray iron scrap, adjusting the relative amounts of each of these three ingredients and, to the extent necessary, and supplementing the molten gray iron by the addition of one or more of silicon, phosphorus, manganese and chromium, as needed." Pg. 3, ll. 11-17.
melting the scrap steel, grey iron ingots	"The molten gray iron metal is prepared in an

and recovered grey iron scrap metal in relative proportions to approximate the molten controlled-content grey iron metal	electric furnace from scrap steel, gray iron ingots, and gray scrap iron recovered from the manufacturing process. The content of the molten gray iron metal is controlled by making spectrographic analyses of the scrap steel, gray iron ingots and recovered gray iron scrap, adjusting the relative amounts of each of these three ingredients and, to the extent necessary, and supplementing the molten gray iron by the addition of one or more of silicon, phosphorus, manganese and chromium, as needed. Because of the general low levels of phosphorus, sulfur and chromium to be maintained in the molten gray iron metal, reduced amounts of alloying metals are necessary, if any." Pg. 3, ll. 11-19.
adjusting the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of the approximated molten controlled-content grey iron metal to the extent necessary to provide the molten controlled-content grey iron metal.	"The molten gray iron metal is prepared in an electric furnace from scrap steel, gray iron ingots, and gray scrap iron recovered from the manufacturing process. The content of the molten gray iron metal is controlled by making spectrographic analyses of the scrap steel, gray iron ingots and recovered gray iron scrap, adjusting the relative amounts of each of these three ingredients and, to the extent necessary, and supplementing the molten gray iron by the addition of one or more of silicon, phosphorus, manganese and chromium, as needed. Because of the general low levels of phosphorus, sulfur and chromium to be maintained in the molten gray iron metal, reduced amounts of alloying metals are necessary, if any." Pg. 3, ll. 11-19.
3. The method of claim 1 wherein the molten controlled-content grey iron metal is alloyed with tin in a percentage dependent on an important section of the part being cast that is required to have the greatest strength and/or machinability	"The percentage of tin to be added to the controlled content gray iron metal in the third step depends upon the more important sections of the part being cast. The important sections are those sections that must have the greatest strength and/or machinability." Pg. 3, ll. 24-26.
4. The method of claim 3 wherein the molten controlled-content grey iron metal is alloyed with tin at the high end of the percentage range for parts with an important section that cools slowly.	"The quantity of tin alloyed with the molten gray iron metal will be at the higher end of the about 0.05% to about 0.10% range, where the temperature of the important section drops more slowly (i.e., cools more slowly) ..." Pg. 3, ll. 28-30.

5. The method of claim 3 wherein the molten controlled-content gray iron metal is alloyed with tin at the low end of the percentage range for parts with an important section that cools quickly.	"The quantity of tin alloyed with the molten gray iron metal will be . . . at the lower end of the range where the important section cools more quickly." Pg. 3, ll. 28-31.
9. A method of casting internal combustion engine parts with grey cast iron, comprising the steps of:	"This invention relates to casting methods using gray cast iron, and more particularly to casting methods for the manufacture of crank cases and cylinder heads with gray cast iron." Pg. 1, ll. 6-7. "A method of the invention for the manufacture of crank cases and cylinder heads from gray cast iron includes the steps of ..." Pg. 2, ll. 10-11.
providing a molten grey iron metal having a carbon equivalent of 4.05%, comprised of about 3.40% to about 3.45% carbon, about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, base iron sulfur of about 0.05% to about 0.07%, manganese of about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium less than about 0.10%	" ... providing a molten gray iron metal having a carbon equivalent of about 4.05%, comprised of about 3.4% to about 3.45% carbon, and about 1.80% to about 1.90% silicon with less than 0.03% phosphorus, while maintaining sulfur of the molten gray iron metal at about 0.05% to about 0.07%, manganese at about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium of less than about 0.10%." Pg. 2, ll. 11-16. See FIG. 1, step one.
alloying said molten grey iron metal prior to pouring with tin to a total tin content of about 0.05% to about 0.10% to provide a molten tin-alloyed grey iron metal	" ... in the pouring ladle, the molten gray iron metal is alloyed with tin to a total tin content of about 0.05% to about 0.10%." Pg. 2, ll. 16-18. "And in the third step, the controlled-content molten gray iron metal is alloyed in the pouring ladle with tin, to a total tin content of about 0.05% to about 0.10% ..." Pg. 3, ll. 21-22. See FIG. 1, third step.
inoculating said molten tin-alloyed grey iron metal prior to pouring with a grey iron inoculant to a further silicon addition of about 0.10% to about 0.12%	"The molten tin-alloyed gray iron metal is inoculated with the silicon-based inoculate to provide a further silicon addition of from about 0.10% to about 0.12% ..." Pg. 2, ll. 18-20. "In the fourth step of the method, the tin-alloyed molten gray metal is inoculated with a silicon-based inoculant(s) [sic], to a silicon addition of between about 0.10% to about 0.12%. Silicon-based inoculants with barium and/or calcium

	are preferred in the practice of this invention." Pg. 3, ll. 34-36. See FIG. 1, fourth step.
casting an internal combustion engine part as soon as possible after said inoculation.	" ... and the resulting inoculated molten tin-alloyed gray iron metal is poured from the ladle into casting molds as soon as possible." Pg. 2, ll. 20-21. "Parts are then cast as soon as possible, and preferably less than 7-10 minutes, after inoculation of tin alloyed molten gray iron metal ..." Pg. 3, line 36-Pg. 4, line 2. See FIG. 1, step five.
10. The method of claim 9 wherein the step of providing the molten controlled content grey iron metal comprises determining the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of scrap steel, grey iron ingots, and recovered grey iron scrap	"The molten gray iron metal is prepared in an electric furnace from scrap steel, gray iron ingots, and gray scrap iron recovered from the manufacturing process. The content of the molten gray iron metal is controlled by making spectrographic analyses of the scrap steel, gray iron ingots and recovered gray iron scrap, adjusting the relative amounts of each of these three ingredients and, to the extent necessary, and supplementing the molten gray iron by the addition of one or more of silicon, phosphorus, manganese and chromium, as needed. Because of the general low levels of phosphorus, sulfur and chromium to be maintained in the molten gray iron metal, reduced amounts of alloying metals are necessary, if any." Pg. 3, ll. 11-19.
melting the scrap steel, grey iron ingots and recovered grey iron scrap metal in relative proportions to approximate the molten controlled-content grey iron metal	"The molten gray iron metal is prepared in an electric furnace from scrap steel, gray iron ingots, and gray scrap iron recovered from the manufacturing process. The content of the molten gray iron metal is controlled by making spectrographic analyses of the scrap steel, gray iron ingots and recovered gray iron scrap, adjusting the relative amounts of each of these three ingredients and, to the extent necessary, and supplementing the molten gray iron by the addition of one or more of silicon, phosphorus, manganese and chromium, as needed. Because of the general low levels of phosphorus, sulfur and chromium to be maintained in the molten gray iron metal, reduced amounts of alloying metals are necessary, if any." Pg. 3, ll. 11-19.

adjusting the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of the approximated molten controlled-content grey iron metal to the extent necessary to provide the molten controlled-content grey iron metal.	"The molten gray iron metal is prepared in an electric furnace from scrap steel, gray iron ingots, and gray scrap iron recovered from the manufacturing process. The content of the molten gray iron metal is controlled by making spectrographic analyses of the scrap steel, gray iron ingots and recovered gray iron scrap, adjusting the relative amounts of each of these three ingredients and, to the extent necessary, and supplementing the molten gray iron by the addition of one or more of silicon, phosphorus, manganese and chromium, as needed. Because of the general low levels of phosphorus, sulfur and chromium to be maintained in the molten gray iron metal, reduced amounts of alloying metals are necessary, if any." Pg. 3, ll. 11-19.
11. The method of claim 9 wherein the molten controlled-content grey iron metal is alloyed with tin in a percentage dependent on an important section of the internal combustion engine part being cast that is required to have the greatest strength and/or machinability	"The percentage of tin to be added to the controlled content gray iron metal in the third step depends upon the more important sections of the part being cast. The important sections are those sections that must have the greatest strength and/or machinability." Pg. 3, ll. 24-26.
12. The method of claim 11 wherein the molten controlled-content grey iron metal is alloyed with tin at the high end of the percentage range for internal combustion engine parts with an important section that cools slowly.	"The quantity of tin alloyed with the molten gray iron metal will be at the higher end of the about 0.05% to about 0.10% range, where the temperature of the important section drops more slowly (i.e., cools more slowly) ..." Pg. 3, ll. 28-30.
13. The method of claim 11 wherein the molten controlled-content grey iron metal is alloyed with tin at the low end of the percentage range for internal combustion engine parts with an important section that cools quickly.	"The quantity of tin alloyed with the molten gray iron metal will be . . . at the lower end of the range where the important section cools more quickly." Pg. 3, ll. 28-31.
14. The method of claim 9 further comprising removing the cast part from its mold while it is in excess of 1400°F.	"The cast parts are removed from the mold while they are at a temperature of over 1400°F ..." Pg. 4, ll. 4-5.
15. A method for casting internal combustion engine parts, comprising	"This invention relates to casting methods using gray cast iron, and more particularly to casting methods for the manufacture of crank cases and cylinder heads with gray cast iron."

	Pg. 1, ll. 6-7. "A method of the invention for the manufacture of crank cases and cylinder heads from gray cast iron includes the steps of ..." Pg. 2, ll. 10-11.
preparing a molten grey iron metal for pouring that comprises a carbon equivalent of about 4.05% with about 3.40% to about 3.45% carbon and about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, base iron sulfur of about 0.05% to about 0.07%, manganese of about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, base iron chromium less than about 0.10% and tin of about 0.05% to about 0.10%	"As illustrated in FIG. 1, the first step in the method of the invention is preparing a molten gray iron base metal having a controlled content." Pg. 3, ll. 10-11. " ... providing a molten gray iron metal having a carbon equivalent of about 4.05%, comprised of about 3.4% to about 3.45% carbon, and about 1.80% to about 1.90% silicon with less than 0.03% phosphorus, while maintaining sulfur of the molten gray iron metal at about 0.05% to about 0.07%, manganese at about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium of less than about 0.10%." Pg. 2, ll. 11-16. See FIG. 1, first step.
by the steps of transforming the molten grey iron metal, absent the tin, to a pouring ladle,	"The molten gray iron base metal is transferred to a pouring ladle ..." Pg. 2, line 16. "In the second step, the controlled content molten gray iron metal is placed in a pouring ladle for further processing." Pg. 3, ll. 20-21. See FIG. 1, second step.
adding tin to the molten grey iron metal in said pouring ladle to said content of about 0.05% to about 0.10%	" ... in the pouring ladle, the molten gray iron metal is alloyed with tin to a total tin content of about 0.05% to about 0.10% ..." Pg. 2, ll. 16-18. "And in the third step, the controlled content molten gray iron metal is alloyed in the pouring ladle with tin, to a total tin content of about 0.05% to about 0.10%, and more preferably 0.055% to about 0.095%, depending on the cross sections of the part being cast." Pg. 3, ll. 21-23. See FIG. 1, third step.
thereafter inoculating the molten grey iron metal with an inoculant to a further silicon addition of from about 0.10% to about 0.12%	"The molten tin-alloyed gray iron metal is inoculated with the silicon-based inoculate to provide a further silicon addition of from about 0.10% to about 0.12% ..." Pg. 2, ll. 18-20. "In the fourth step of the method, the tin alloyed molten gray metal is inoculated with a silicon-based inoculant(s) [sic], to a silicon addition of between about 0.10% to about 0.12%. Silicon-

	based inoculants with barium and/or calcium are preferred in the practice of this invention." Pg. 3, ll. 34-36. See FIG. 1, fourth step.
pouring the molten grey iron metal as soon as possible after said inoculation into a casting mold	" . . . the resulting inoculated molten-tin-alloyed gray iron metal is poured from the ladle into casting molds as soon as possible ..." Pg. 2, ll. 20-21. "Parts are then cast as soon as possible, and preferably less than 7-10 minutes, after inoculation of tin alloyed molten gray iron metal ..." Pg. 3, ll. 76-Pg. 4, ll. 2. See FIG. 1, step five.
shaking the resulting casting out of the casting mold while at a temperature over 1400°F	"The method of the invention ... has the advantage of short cooling time, that is, a hot shake-out temperature," Pg. 2, ll. 7-9. "Further, the hot shake-out temperatures for the resulting castings also minimizes the need for alloy addition and provides castings with lower residual stresses." Pg. 2, ll. 28-29. "The cast parts are removed from the mold while they are at a temperature off over 1400°F ..." Pg. 4, ll. 4-5.
16. The method of claim 15 wherein the resulting casting includes an important section that cools slowly and the molten grey iron metal, when poured, has a total tin content of about 0.10%.	"The percentage of tin to be added to the controlled content gray iron metal in the third step depends on the more important sections of the part being cast. The important sections are those sections that must have the greatest strength and/or machinability. An important section may be either a thinner or thicker section of the casting, depending upon the function of the section. The quantity of tin alloyed with the molten gray iron metal will be at the higher end of about 0.05% to about 0.10% range, where the temperature of the important section drops more slowly (i.e., cools more slowly) ... Even a thinner section of a casting may require the addition of alloying tin at the higher end of the range if the temperature cools slowly as a result of adjacent heavy casting sections that act as heat sources for the thinner sections." Pg. 3, ll. 24-33.
17. The method of claim 15 wherein the resulting casting includes an important section that cools quickly and the molten grey iron	"The percentage of tin to be added to the controlled content gray iron metal in the third step depends on the more important sections of

metal, when poured, has a total tin content of about 0.05%.	the part being cast. The important sections are those sections that must have the greatest strength and/or machinability. An important section may be either thinner or thicker section of the casting, depending upon the function of the section. The quantity of tin alloyed with the molten gray iron metal will be ... at the lower end of the range where the important section cools more quickly." Pg. 3, ll. 24-31.

VI. THE GROUNDS OF REJECTION (37 C.F.R. § 41.37(c)(1)(vi))

The rejection of the Examiner on appeal is based on 35 U.S.C. § 103(a), obviousness, in view of two (2) cited references. There are no other rejections for review.

In the Examiner's only rejection, claims 1-5 and 9-17 are rejected as being unpatentable over Tache et al. (U.S. Patent No. 3,299,482), in view of Bostater et al. (U.S. Patent No. 4,493,359).

In the rejection, the Examiner states:

> Tache et al. disclose a gray iron casting process and composition for making engine component parts by adding a tin alloying element, in which the composition includes (by weight percent): 3.05 to 3.45% carbon (carbon equivalent between 3.76 and 4.15%), 1.7 to 2.1% silicon, maximum 0.15% phosphorus, maximum 0.12% sulfur, 0.5 to 0.9% manganese, maximum 0.15% chromium, 0.05 to 0.08% tin, and balance iron (column 1, lines 11-16; column 3, lines 1-56 and 70-76; and column 4, lines 1-46). Preferably, the tin is added to the molten gray iron in the cupola during filling of the pouring ladles by addition of preweighed chunks of metallic tin in the range of 0.05 to 0.08% by weight, resulting in a molten alloy of tin with gray iron, followed by subsequent (as soon as possible) casting into mold(s) to produce the engine components (column 3, line 75; and column 4, lines 1-46). After the molten gray iron composition is poured into molds while the molten metal is at about 2550 to 2650 degrees F, the resulting casting is cooled and taken to core knockout and shakeout stations while the bores are still at temperatures of about 1450-1500 degrees F (column 1, lines 55-70). Although Tache et al. disclose a composition that includes silicon within the gray iron alloy, Tache et al. do not disclose the step of adding further silicon as an inoculant to the molten gray iron alloy.
>
> However, Bostater et al. disclose a method for making cast iron engine blocks from a casting process with molten gray iron, in which a silicon-containing inoculant (foundry grade ferrosilicon containing 23% iron and 7.5% silicon, ranging from 100 to 300 ounces of inoculant per 1,600 pounds of molten metal) is added to a molten gray iron composition (that already contains silicon) and stirred with a casting ladle for subsequent pouring into casting molds (abstract; column 1, lines 6-13; column 3, lines 3-21 and 52-68; column 4, lines 1-3 and 50-60; column 5, lines 54-68; column 6, lines 1-15; column

7, lines 4-26; and Figure). A sample of molten metal in the holding furnace was taken periodically for thermal analysis to obtain control of the carbon equivalent value (at a desired level of about 4%) within the molten gray iron (column 5, lines 42-53; and Figure). Castings of various cross-sections, including those that have very thin walls which would otherwise have high casting scrap losses, are able to be produced due to the molten metal homogeneity and addition of silicon-containing inoculant, with the advantageous feature of achieving a low casting scrap rate of less than 5% (column 2, lines 21-45; column 3, lines 3-21 and 33-40; column 4, lines 44-65; column 5, lines 54-68; column 6, lines 1-15; and column 7, lines 23-39). The additional step of adding a silicon-containing inoculant is advantageous for producing gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (column 4, lines 44-49; column 5, lines 57-68; column 6, lines 1-15; and column 7, lines 23-40).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the gray iron casting process and composition for making engine component parts by adding a tin alloying element, as disclosed by Tache et al., by using the additional step of adding and stirring a silicon-containing inoculant to a molten gray iron composition that already includes silicon, as taught by Bostater et al., in order to produce gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (Bostater et al.; column 4, lines 44-49; column 5, lines 57-68; column 6, lines 1-15; and column 7, lines 23-40).

VII. ARGUMENT (37 C.F.R. § 41.37(c)(1)(vii))

Applicant has invented the time-ordered combination of alloying and casting steps set forth in the claims on appeal, without additional processing equipment, to provide an economical method of manufacturing gray iron crank cases and cylinder heads and other internal combustion engine parts that have minimal iron carbide hard spots and chills upon solidification and minimal need for stress relief heat treatment prior to machining.

Mr. Joseph R. Ward, the inventor, has a Bachelor of Science degree in Metallurgical Engineering and over thirty years of experience as a metallurgist working in casting operations. Mr. Ward has studied the Tache et al. and Bostater et al. patents and has submitted a Declaration in this application, a copy of which is included in Evidence Appendix at Tab 1.

1. THE EXAMINER HAS FAILED TO GIVE DUE CONSIDERATION TO APPLICANT'S EVIDENCE SUBMITTED PURSUANT TO 37 C.F.R. § 1.132, OR, IN ANY EVENT, HAS FAILED TO EXPLAIN WHY APPLICANT'S EVIDENCE IS INSUFFICIENT TO OVERCOME THE REJECTION OF THE CLAIMS OF THIS APPLICATION

In response to the first Office Action of the Examiner in this application, Applicant submitted a Declaration pursuant to 37 C.F.R. § 1.132, which is attached to this Brief in its

Evidence Appendix at Tab 1. In the Final Office Action, mailed October 17, 2003, which is attached hereto at Tab 2, the Examiner acknowledged receipt of the inventor's Declaration in paragraph 5 of the Office Action, and in paragraph 6 stated only, "With regard to applicant's arguments on pages 7-12 of the amendment, as well as the declaration under 37 USC [sic] 1.132, the examiner has considered the major issues as follows: . . .2) on pages 8 and 9, the applicant (in both the amendment and the declaration) has argued the term 'as soon as possible' is a significant feature in the claims . . ." Other than these references, there is nothing in the Office Action indicating consideration of the specific evidence presented by way of Applicant's Declaration, and nothing to explain why the Examiner considered Applicant's evidence to be insufficient to overcome the rejection.

After a Request for Continued Examination, in the first Office Action mailed April 26, 2004, the only reference to the inventor's Declaration is in paragraph 5, which states, "With regard to applicant's arguments on page 6 of the amendment/remarks, as well its reference to the inventor's declaration under 37 USC [sic] 1.132, the examiner has previously addressed the main issues in the final rejection mailed October 17, 2003, and the advisory action mailed January 27, 2004 . . ."

And in the Final Office Action mailed August 12, 2004, which is under appeal, attached at Tab 3, the only reference to Applicant's Declaration is in paragraph 4, "With regard to applicant's arguments on pages 7-13 of the amendment/remarks, as well as its reference to the inventor's declaration under 37 USC [sic] 1.132, the examiner has previously addressed several critical issues (that the applicant also currently presents) in the final rejection mailed October 17, 2003, the advisory action mailed January 27, 2004, and the prior non-final Office Action mailed April 26, 2004. . .")

MPEP 716.01 Generally Applicable Criteria [R-2] includes:

(B) Consideration Of Evidence

> Evidence traversing rejections, when timely presented, must be considered by the examiner whenever present. All entered affidavits, declarations and other evidence traversing rejections are acknowledged and commented upon by the examiner in the next succeeding action. The extent of the commentary depends on the action taken by the examiner. . . .Where the evidence is insufficient to overcome the rejection, the examiner must specifically explain why the evidence is insufficient. General statements such as "the evidence lacks technical validity" or "the evidence is not commensurate with the scope of the claims" without an explanation supporting such findings are insufficient. (Page 700-255, Rev. 2, May 2004.)

The office actions of the Examiner do not indicate that the Declaration submitted in this application has received the due consideration to which it is entitled. For example, the Court of Customs and Patent Appeals stated in In re Oelrich and Divigard, 579 F.2d 86, 91-92, 198 U.S.P.Q. 210, 215 (CCPA 1978),

> While we concur in the sentiment expressed by the Board that showings of fact are much preferred to statements of opinion, we are of the view that the nature of the matter sought to be established, as well as the strength of the opposing evidence, must be taken into consideration in assessing the probative value of expert opinion. In this case, the expert opinions were introduced on the level of ordinary skill, which is usually determined by reference to the subjective reaction of persons so skilled. In re Meng, 492 F.2d 843, 181 USPQ 94 (CCPA 1974), and are opposed by a fragile prima facie case of obviousness. In our opinion, the affidavits were sufficient to shift the burden of going forward with evidence back to the PTO, and that burden has not been sustained. In other words, the prima facie case of obviousness has been overcome.

In addition, the Declaration submitted by Applicant may not be disregarded by the Examiner merely because it has been made by the inventor. See In re McKenna, Redmond and Smith, 203 F.2d 717, 97 U.S.P.Q. 348 (CCPA 1953) and the cases cited therein. Applicant's Declaration confirms that the claimed invention as a whole was not obvious to one of ordinary skill in the art.

If the Examiner has given Applicant's Declaration the consideration required by law, which is not apparent from the record, he has certainly failed to specifically explain why he considered Applicant's Declaration to be insufficient.

2. THE EXAMINER'S REJECTION IS THE RESULT OF IMPROPER HINDSIGHT BASED ON APPLICANT'S DISCLOSURE

MPEP Section 2142 rather nicely states the procedure to be followed by the Examiner in determining obviousness under 35 U.S.C. § 103:

> To reach a proper determination under 35 U.S.C. 103, the examiner must step backward in time and into the shoes worn by the hypothetical "person of ordinary skill in the art" when the invention was unknown and just before it was made. In view of the all factual information, the examiner must then make a determination whether the claimed invention "as a whole" would have been obvious at that time to that person. Knowledge of the applicant's disclosure must be put aside in reaching this determination, yet kept in mind in order to determine the "differences," conduct the search and evaluate the "subject matter as a whole" of the invention. The tendency to resort to "hindsight" based upon applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and a legal conclusion must be reached on the basis of the facts gleaned from the prior art. (Page 2100-123-2100-124, Rev. 1, Feb. 2003.)

Applicant respectfully submits that the Examiner has been unable to avoid the tendency to resort to impermissible hindsight in his selection and interpretation of the cited references.

For example, Applicant's evidence at paragraph 6 of the Declaration in the Evidence Appendix at Tab 1 states,

> Furthermore, I do not believe a skilled metallurgist, trying to develop castings with high strength, minimal iron carbide hard spots and chills, low residual stresses and reduced casting times without additional equipment, would combine the teachings of the Tache patent and Bostater et al. patent, whose teachings are directed to different problems.

Thus, a graduate metallurgist who has worked with metallurgy and casting operations for over 31 years indicates that a person of ordinary skill in the art would not combine the teachings of the cited references as the Examiner has. Applicant further states in paragraph 6 of his Declaration,

> I do not believe the combined teachings of the Tache patent and Bostater et al. patent teach our casting method. The combined teachings of the Tache and Bostater et al. patents do not teach a casting method in which a molten grey iron with very low levels of carbide stabilizers and a low level of tin is inoculated with silicon to a level of about 0.10% to about 0.12%, is poured as soon as possible after inoculation, and in which the resulting castings are removed from the molds at over 1400° F.

Applicant further submits that an objective consideration of the cited references discloses no motivation or suggestion to combine the references, as in the Examiner's rejection. As indicated in paragraph 6 of Applicant's Declaration, the teachings of the Tache et al. and Bostater patents are directed to different problems. Tache et al. state, for example, in Col. 1, lines 11-14,

> This invention relates to improvements in the foundry production of gray iron castings for applications such as engine blocks, brake drums and like articles <u>where good wear properties and high strength are demanded</u> . . . (Emphasis added)

and further state, for example, in describing the results of casting with the prior art composition set forth at Col. 2, lines 16-25, which does not contain any alloying tin,

> ... repeated field complaints of high incidents of bore wear and oil consumption on engines reveal on investigation that the bores were quite soft, as low as 110 Brinnell, and had a microstructure unsuitable for the type of surface to which the castings were subjected. (Col. 2, lines 27-32).

Tache et al. further state,

> Further investigation showed that most of the soft blocks were either the result of a normal shut-down of the foundry molding and cooling line conveyors described above such as for lunch hour, shift changes or overnight stoppage or due to unforeseeable line stoppages because of equipment failures. In each of these instances, the castings were retained for extended periods in the mold [sic] or on cooling conveyors prior to core

> knock-out. Such permitted the bores to self-anneal because the slow cooling rates through the secondary graphitizing range of approximately 1450°F to 1200°F. (Col. 2, lines 38-48).

Tache et al.'s solution to this problem was,

> ... to treat or modify the gray iron composition to stabilize the microstructure during periods of slow cooling to minimize the production of soft bores and poor wearing surfaces on the castings. (Col. 2, lines 61-64).

Bostater et al. were concerned with a different problem, described, for example, as follows,

> By far most of the defects occur in the thinnest wall portions of the casting, and the thinner the walls, the greater the scrap loss. At present, a scrap loss of about five percent in the casting operation is accepted by the industry as being nominal for engine blocks wherein the minimum wall thickness is about 0.180 inches. For engine blocks having substantially smaller wall thicknesses, for example, 0.150 inches, there is a dramatic increase in scrap loss, typically to as high as twenty-five percent. Such scrap losses are prohibitive as regards to manufactured engine blocks for high production automobiles and trucks, and hence it is currently the practice of the automotive industry to design all high production engines to have engine block wall thicknesses of at least 0.180 inches. It is this limitation on the design of engine blocks that has been an ever-increasing problem in the attainment of lesser gross vehicle weight.
>
> The present invention solves this problem by providing a method whereby cast iron engine blocks can be made with wall thicknesses substantially less than are now used, without any increase in scrap loss . . . A cardinal feature of the method of the present invention is that after the molten grey iron metal is made it is held at a substantially constant temperature for a period of from one and one-half to two and one-half hours prior to being poured into the mold. (Col. 2, lines 23-53).

As indicated in Applicant's evidence and in the cited references themselves, Tache et al. and Bostater et al. are directed to problems different from each other and from the problem solved by Applicant's claimed invention. Thus, Applicant respectfully submits the selection and combination of the cited references by the Examiner has been based on impermissible hindsight and the result of Applicant's disclosure and not any motivation or suggestion present in the cited references.

3. THE CITED REFERENCES DO NOT TEACH APPLICANT'S INVENTION AS RECITED IN CLAIMS 1-5 and 9-17

It is axiomatic that any determination of patentability must consider the claimed invention "as a whole." As set forth in the MPEP,

2143.03 ALL CLAIM LIMITATIONS MUST BE TAUGHT OR SUGGESTED

> To establish *prima facie* obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970)... (Page 2100-128, Rev. 1, Feb. 2003.)

Further, indefinite limitations must be considered, and it is improper to rely on speculative assumptions regarding the meaning of a claim and then base the rejection under 35 U.S.C. 103 on these assumptions. In re Steele, Mills and Leis, 305 F.2d 859, 134 U.S.P.Q. 292 (CCPA 1962).

Applicant respectfully submits that the combination of the cited references does not teach or suggest the claimed invention as a whole as recited in claims 1-5 and 9-17.

3A. CLAIM 9 AND THE CLAIMS DEPENDENT THEREON WERE NOT OBVIOUS

In the rejection, the Examiner states,

> Tache et al. disclose a gray iron casting process and composition for making engine component parts by adding a tin alloying element, in which the composition includes (by weight percent): 3.05 to 3.45% carbon (carbon equivalent between 3.76 and 4.15%), 1.7 to 2.1% silicon, maximum of 0.15% phosphorus, maximum of 0.12% sulfur, 0.5 to 0.9% manganese, maximum 0.1% chromium, 0.05 to 0.08% tin and balance iron. (citing Col. 1, lines 11-16; Col. 3, lines 1-56; and Col. 4, lines 1-46).

Notwithstanding the lengthy citation to the Tache et al. patent, the Examiner's statement refers to the composition recited at Col. 3, lines 41-49, and the citation of that portion of Tache et al. is apparently responsive to the following portion of Applicant's claim 9:

> ...providing a molten grey iron metal having a carbon equivalent of about 4.05%, comprised at about 3.40% to about 3.45% carbon, about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, base iron sulfur of about 0.05% to about 0.07%, manganese of about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium less than about 0.10%.

The Examiner argues, in part, that because the ranges of the elements of Tache et al.'s composition, and the ranges of the elements set forth in Applicant's claims overlap, this, in part, establishes the obviousness of Applicant's invention. While the composition used in Applicant's method is different, as acknowledged by the Examiner, Applicant will not contest in this appeal that the differences between the ranges of elements of the composition defined by his claims

over the composition of elements disclosed in the Tache et al. patent at Col. 3, lines 41-49, by themselves, render the subject matter of claims 9-14 to be non-obvious.

The rejection, however, further states,

> Preferably, the tin is added to the molten gray iron in the cupola during filling of the pouring ladles by addition of pre-weighed chunks of metallic tin in the range of 0.05 to 0.08% by weight, resulting in a molten alloy of tin with gray iron, followed by a subsequent (as soon as possible) casting into the molds to produce the engine components. (Col. 3, line 75; and Col. 4, lines 1-46).

With respect to this portion of the rejection, it is apparently directed at the following subject matter of Applicant's claim 9:

> . . .alloying said molten grey-iron metal prior to pouring with tin to a total tin content of about 0.05% to about 0.10% to provide a molten tin-alloyed grey-iron metal;
> * * *
> casting an internal combustion engine part as soon as possible after said inoculation.

The omission from the quoted portion of Applicant's claim 9 that is indicated by asterisks above relates to the step of inoculating the molten grey iron metal with an inoculant to a further silicon addition of about 0.10% to about 0.12%, which the Examiner acknowledges is not disclosed by Tache et al. Accordingly, the Examiner acknowledges that Tache et al. does not disclose Applicant's claimed invention as a whole, and, as a result, has cited Bostater et al., which is discussed further below.

Assuming *arguendo* that Tache et al. disclose the step of adding tin to the molten grey iron metal during the filling of the pouring ladles in percentages overlapping those recited in Applicant's claims, Applicant submits, however, that Tache et al. does not teach the step of "casting an internal combustion part as soon as possible after said inoculation," in claims 9-14.

In the rejection, the Examiner refers to Col. 3, line 75, through Col. 4, line 46, in support of this portion of the rejection. Applicant respectfully submits that there is no disclosure in Tache et al. at Col. 3, line 75, through Col. 4, line 46, of Applicant's claimed step of casting an internal combustion engine part as soon as possible after said inoculation. Tache et al. contains no disclosure indicating that time is a factor that should be reduced following an inoculation of the molten, tin alloyed, controlled-content grey iron metal because Tache et al., among other things, does not teach the inoculation of molten, tin alloyed, controlled-content grey iron metal to a further silicon addition of from about 0.10 to 0.12%. In addition, Tache et al.'s only disclosure

regarding time involved in pouring is at Col. 1, lines 54-57, "The ladles are then transferred to the pouring line and the molds are filled at the prescribed temperature (2550°F to 2650°F) at a proper rate." Tache et al. does not disclose that an internal combustion engine part should be cast as soon as possible after inoculation.

The Examiner further comments in this regard as follows:

> Second, the limitation "as soon as possible" (as discussed on page 8 of applicant's remarks), when taken in view of a "pouring" step does not set forth an inventive step, nor is it even quantitative. Furthermore, if molten metal is not poured "as soon as possible" from a pouring ladle (most of which were unheated at the time of both prior art references in the 35 U.S.C. [sic] 103(a) rejection), there is an increased risk of oxide inclusions upon casting, as well as increased solidification of metal within the ladle, such that one of ordinary skill in the art would have recognized that pouring "as soon as possible" is an obvious course of action to take in practically any molten metal pouring process.

The Examiner's remarks, "the limitation 'as soon as possible,' . . . when taken in view of a 'pouring' step does not set forth an inventive step nor is it even quantitative," indicates that the Examiner has given "as soon as possible" no weight, and has not considered Applicant's invention as a whole. As indicated above, even indefinite claim limitations must be considered in considering the invention as a whole. (MPEP Section 2143.03).

In addition, the Examiner states,

> . . . Furthermore, if the molten metal is not poured "as soon as possible" from the pouring ladle (most of which were unheated at the time of both prior art references in the 35 U.S.C. [sic] 103(a) rejection), there is an increased risk of oxide inclusions upon casting, as well as increased solidification of metal within the ladle, such that one of ordinary skill in the art would have recognized that pouring "as soon as possible" is an obvious course of action to take in practically any molten metal pouring process.

Applicant submits that there is no evidence of record to support this statement of the Examiner. As set forth in MPEP Section 2144.03, Section A,

> It is never appropriate to rely solely on "common knowledge" in the art without evidentiary support in the record, as the principle evidence upon which a rejection is based. *Zurko*, 258 F.3d at 1385, 59 USPQ 2d at 1697 ("[T]he Board cannot simply reach a conclusion based on its own understanding or experience - or on its assessment of what would be a basic knowledge or common sense. Rather, the Board must point to some concrete evidence in the record in support of these findings.") (Page 2100-132, Rev. 1, Feb. 2003.)

Contrary to the Examiner's statement that ". . . tin is added to the molten grey iron in the cupola during filling of the pouring ladles by addition of pre-weighed chunks of

metallic tin in the range of 0.05 to 0.08% by weight, resulting in a molten alloy of tin, followed by a subsequent (as soon as possible) casting into the molds to produce engines comments," Applicant's evidence is, "Tache et al. do not teach inoculation of a molten grey iron to a further silicon content of about 0.10% to about 0.12% silicon, pouring as soon as possible after inoculation and shaking out the casting while they are over 1400°F." (Applicant's Declaration, Tab 1, paragraph 4) (emphasis added). As indicated above, Tache et al. do not disclose or teach that a molten, tin-alloyed, controlled-content grey iron metal, as claimed, should be used in casting as soon as possible after inoculation.

Further Bostater et al. teach that:

> A cardinal feature of the method of the present invention is that after the molten grey metal is made it is held at a substantially constant temperature for a period of from one and one-half to two and one-half hours prior to being poured into the molds." (column 2, lines 48 -53)

Thus neither Tache et al. nor Bostater et al nor their combination teach the "as soon as possible" limitation of Applicant's claims. Indeed Bostater et al. teaches to the contrary.

Turning to the alloy composition, the Examiner has erroneously treated Tache et al.'s disclosure as equivalent to Applicant's invention of claim 9, except for the step of adding further silicon as an inoculant to the molten gray alloy.

The molten, tin alloyed, controlled-content grey iron metal used in Applicant's claimed method is different from the alloy disclosed by Tache et al. Tache et al.'s alloy includes manganese in an amount of 0.5 to 0.9%; Applicant's teaching is to use manganese at about 1.7 times the percentage of sulfur, plus about 0.3 to about 0.4%. Tache et al. teach that phosphorus can be used up to 0.15% while Applicant's alloy contains less than about 0.03% phosphorus. Tache et al. teach that sulfur can be up to 0.12%, while in Applicant's alloy, sulfur is maintained at about 0.05 to about 0.07%, and Tache et al.'s alloy may have chromium of up to 0.15%, while in Applicant's alloy the chromium is less than 0.10%. While the differences between the alloy used in Applicant's claimed methods and the alloy taught by Tache et al. may not establish, in and of themselves, that Applicant's claimed methods are patentable, they must be considered in combination with the other differences between Applicant's claimed methods in considering the patentability of Applicant's invention as a whole.

As set forth in paragraph 4 of the Applicant's Declaration at Tab 1,

> The Tache patent does not teach our method. The Tache patent does not teach the use of low levels of carbide stabilizers, reduced casting times and hot casting shake out. To the contrary, Tache's castings remain in the molds such long times that Tache adds tin to stabilize the hardness of the casting, and Tache does not teach inoculation of a molten grey iron to a further silicon content of about 0.10% to about 0.12% silicon and pouring as soon as possible after inoculation, and shaking out the castings while they are over 1400°F. In addition, Tache uses high levels of chromium and phosphorus, both of which promote hard spots in castings.

While Tache et al. disclose alloying their gray iron alloy (which is different than Applicant's alloy) with tin, in the preferable amount of 0.05% to 0.08%, Tache et al. do not disclose the steps of "inoculating said molten tin-alloyed grey iron metal prior to pouring with a grey iron inoculant to a further silicon addition of from about 0.10% to about 0.12%," and "casting an internal combustion engine part as soon as possible after said inoculation."

As set forth above, Tache et al. contains <u>no</u> disclosure indicating that time is a factor that should be reduced following the inoculation of the molten tin-alloyed controlled content grey iron metal because Tache et al.'s only disclosure regarding the time involved in pouring is at column 1, lines 54-57, "The ladles are then transferred to the pouring line and the molds are filled at the prescribed temperature (2550°F to 2650°F) at a proper rate." The Tache et al. disclosure does not teach that an internal combustion engine part should be cast as soon as possible after inoculation of a molten tin-alloyed, inoculated controlled content grey iron metal, as claimed.

Furthermore, the problem that motivated Tache et al. in their invention was different than the motivation for Applicant's invention. Tache et al. state, for example, in describing the results of a casting with the composition set forth at column 2, lines 16-25, which does not contain any alloying tin, "...repeated field complaints of a high incidence of bore wear and oil consumption on engines revealed on investigation that the bores were quite soft, as low as 110 Brinell and had a microstructure unsuitable for the type of service to which the castings were to be subjected." (column 2, lines 26-32). Tache et al. further state,

> Further investigation showed that most of the soft blocks were either the result of normal shutdown of the foundry molding and cooling line conveyors described above such as for lunch hour, shift changes, or overnight stoppage, or due to unforeseeable line stoppages because of equipment failures. In each of these instances the castings were retained for extended periods in the molds or on the cooling conveyors prior to core knock-out. Such

> permitted the bores to self-anneal because of the slow cooling rate through the secondary graphitizing range of approximately 1450°F to 1200°F. (column 2, lines 38-48).

Tache et al.'s solution to this problem was

> ...to treat or modify the gray iron composition to stabilize the microstructure during the periods of slow cooling to minimize the production of soft bores and poor wearing surfaces on the castings. In this connection, it had been found that these soft castings were evidenced by the formation of substantial amounts of free ferrite and that control of this action, if possible, could be beneficial. (column 2, lines 61-68).

Tache et al. further state,

> ...it was found that if tin in certain critical quantities in the range of 0.04 to 0.10 was used in gray iron compositions of the above general character, that it was possible to obtain satisfactory castings substantially free of soft bores and having high wear resistant surfaces by the normal production methods that had previously caused the above described difficulties when normal or abnormal stoppages occurred in the casting line. (column 3, lines 18-26).

On the other hand, Applicant's invention sought an economical method for manufacturing gray iron crank cases and cylinder heads having minimal iron carbide hard spots and chills upon solidification, minimal need for stress relief treatment of the finished casting and shortened cooling times. See Applicant's specification, page 2, lines 5-9. As a result of Applicant's invention, this method of manufacture uses a molten gray iron metal that has, compared with prior manufacturing methods, substantially increased carbon levels, lower levels of phosphorus, significantly lower levels of chromium, somewhat lower levels of sulfur, which, with the alloying use of tin as a pearlite stabilizer, substantially reduces the potential for carbide hard spots and chills and allows significantly reduced silicon content in the gray iron and minimal inoculation additions while providing castings with lower residual stresses. See Applicant's specification, page 2, lines 23-29, and paragraphs 3 and 4 of Applicant's Declaration, at Tab 1.

As indicated above, Tache et al. disclose the use of phosphorus up to 0.15%, five times the level of phosphorus used in Applicant's method; Tache et al. disclose the use of chromium up to 0.15%, one and one-half times the level of chromium used in Applicant's method, and Tache et al. do not disclose an inoculation of his alloy to a further silicon addition of 0.10% to about 0.12% silicon, and casting an internal combustion engine part as soon as possible after said inoculation.

The Examiner has cited Bostater et al., U.S. Patent No. 4,493,359, as disclosing the inoculation steps of Applicant's claims that are acknowledged by the Examiner to be missing from the teachings of Tache et al. Bostater et al. has no disclosure, teaching or suggestion of the use of the alloy used in Applicant's claimed methods and no disclosure, teaching or suggestion of the use of tin, whatsoever. The Examiner's reliance on Bostater et al. ignores the teachings of Bostater et al. that are contrary to Applicant's claimed invention.

The combination of Tache et al. and Bostater et al., U.S. Patent No. 4,493,359, fails to disclose, teach or suggest Applicant's invention. Tache et al. and Bostater et al. have disparate disclosures and would not be combined by one of ordinary skill in the art as the Examiner has combined them. The Examiner's combination of Tache et al. and Bostater et al. can only be the result of his <u>hindsight</u> view of the references, resulting from Applicant's invention.

As set forth in paragraph 6 of Applicant's declaration,

> I do not believe the combined teachings of the Tache et al. patent and Bostater et al. patent teach our casting method. The combined teachings of the Tache et al. and Bostater et al. patents do not teach a casting method in which a molten grey iron with very low levels of carbide stabilizers and a low level of tin is inoculated with silicon to a level of about 0.10% to about 0.12%, is poured as soon as possible after inoculation, and in which the resulting castings are removed from the molds at over 1400°F. Furthermore, I do not believe a skilled metallurgist, trying to develop castings with high strength, minimal iron carbide hard spots and chills, low residual stresses in reduced casting times and without additional equipment, would combine the teachings of the Tache patent and the Bostater et al. patent, whose teachings are directed to different problems.

The problem with which Bostater et al. were concerned is described, for example, as follows,

> "By far most of the defects occur in the thinnest wall portions of the castings, and the thinner the walls, the greater the scrap loss. At present, a scrap loss of about five percent in the casting operation is accepted by the industry as being nominal for engine blocks wherein the minimum wall thickness is about 0.180 inches. For engine blocks having substantially smaller wall thicknesses, for example, 0.150 inches, there is a dramatic increase in scrap loss, typically to as high as twenty-five percent. Such scrap losses are prohibitive as regards the manufacture of engine blocks for high production automobiles and trucks, and hence it is currently the practice of the automotive industry to design all high-production engines to have engine block wall thicknesses of at least 0.180 inches. It is this limitation on the design of engine blocks that has become an ever-increasing problem in the attainment of lesser gross vehicle weight.
>
> The present invention solves this problem by providing a method whereby cast iron engine blocks can be made with wall thicknesses substantially less than are now used, without any increase in scrap loss...A cardinal feature of the method of the present invention is that after the molten grey metal is made it is held at a substantially constant

temperature for a period of from one and one-half to two and one-half hours prior to being poured into the molds." (column 2, lines 23-53).

Bostater et al. also state,

Because the temperature in the molten metal in the holding furnace is maintained substantially constant, during the lengthy residence time of the molten metal in the holding furnace there is attained not only an increase in homogeneity of the metal composition but also an increase in the uniformity of the temperature of the molten metal throughout its mass. The increased uniformity in composition and the increased uniformity in temperature are important not only in and of themselves but also important in better assuring a constancy in the fluidity of the molten metal. With this increased uniformity in composition, temperature and fluidity, the flow and the cooling of the molten metal poured into the mold are of an improved, controlled uniformity. (column 3, lines 3-18).

Bostater et al. further state that in their invention,

The metal formulation can be any of those well known in the art for machinable grey cast iron, preferably having a chemistry <u>as poured</u>, which includes, by weight, from 3.30% to 3.60% C, from 2.10% to 2.65% Si, from 0.05% to 0.09% P, from 0.5% to 0.7% Mn, from 0.15% to 0.25% Cr, from 0.1% to 0.15% Ni, and from 0.15% to 0.25% Cu, 0.15% maximum S and the remainder Fe. (column 3, lines 51-59, Emphasis Added).

This metal formulation <u>is devoid of tin</u> and is different from both Tache et al.'s metal alloy and the alloy used in Applicant's invention. Bostater et al. disclose an alloy having substantially higher values of silicon, phosphorus and chromium than those used in Applicant's method, and unlike Applicant's method, Bostater et al. disclose the use of quantities of nickel and copper, and the use of manganese in an amount equal to 0.61%.

Bostater et al. do disclose the inoculation of their alloy with a ferrosilicon inoculant; however, Bostater et al. do not disclose Applicant's step of inoculating Applicant's molten tin-alloyed, controlled content gray iron metal with a grey iron inoculant to a further silicon addition of from about 0.10% to about 0.12%.

Bostater et al. are interested only in obtaining molten metal with sufficient fluidity to reliably form walls having a thickness of about 0.150 inches. Unlike Applicant's invention, Bostater et al. do not disclose a concern with minimizing iron carbide hot spots and chills upon solidification, minimizing the need for stress relief heat treatment of the finished castings, or minimizing cooling times, by obtaining hot shake-out temperatures. Unlike Applicant's method of manufacture, Bostater et al. do not disclose or teach lower levels of phosphorus, significantly lower levels of chromium, somewhat lower levels of sulfur and the alloying use of tin as a pearlite stabilizer to substantially reduce the potential for iron carbide hot spots and chills, and do

not teach a significantly reduced silicon content and minimal inoculate additions. Contrary to Applicant's invention, Bostater et al. teach the use of expensive alloying agents copper and nickel that are no part of Applicant's invention.

Paragraph 3 of Applicant's Declaration states:

> "In our method, very low levels of carbide stabilizers, such as chromium and phosphorus, and a very low level of tin, are used in molten grey iron casting metal, which is inoculated with silicon to a level of about 0.10% to about 0.12% while it is in the pouring ladle, and poured as soon as possible after inoculation, and the castings are shaken out while hot, in excess of 1400°F."

Even if Tache et al. and Bostater et al. were combinable, which is contrary to Applicant's Declaration, their combined teachings would, contrary to the invention, provide an alloy with about twice the percentage of the carbide stabilizer phosphorus, about one hundred fifty percent of the carbide stabilizer chromium that are used in Applicant's method, and would further include 0.15% to 0.25% nickel and 0.15% to 0.25% copper. Such teachings are contrary to the invention and Applicant's use of "very low levels of carbide stabilizers," and cannot be ignored.

Furthermore, Applicant's invention requires no additional processing equipment, however, as stated by Bostater et al., "Further, in accordance with the preferred embodiment, this is accomplished by the use of <u>a holding furnace of massively increased capacity</u>, as compared to the holding furnaces heretofore used." (column 2, lines 52-56). (Emphasis Added).

Thus, one of ordinary skill in the art would not combine the teachings of Bostater et al. with those of Tache et al., and in any event, their combination would not achieve the results sought by Applicant by the invention of claim 9 and the claims dependent therefrom, i.e., an economical method of manufacturing grey iron castings with minimal iron carbide hotspots and chills, minimal need for stress relief, a requirement of no additional processing equipment.

<u>3B. CLAIMS 1, 14 AND 15 AND THE CLAIMS DEPENDENT FROM CLAIMS 1 AND 15 WERE NOT OBVIOUS</u>

Turning to Claims 1, 14, and 15, the Final Action states:

> Tache et al. disclose a gray iron casting process and composition for making engine component parts by adding a tin alloying element, in which the composition includes (by weight percent): 3.05 to 3.45% carbon (carbon equivalent between 3.76 and 4.15%), 1.7 to 2.1% silicon, maximum of 0.15% phosphorus, maximum of 0.12% sulfur, 0.5 to 0.9%

manganese, maximum 0.1% chromium, 0.05 to 0.08% tin and balance iron. (citing Col. 1, lines 11-16; Col. 3, lines 1-56; and Col. 4, lines 1-46).

As indicated above, the statement refers to the composition recited at Col. 3, lines 41-49. The citation of that portion of Tache et al. is apparently responsive to the following portion of Applicant's claims:

Claims 1-5

> . . .providing a molten controlled-content grey iron metal having a carbon equivalent of about 4.05%, comprised of 3.40% to about 3.45%, about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, while maintaining base iron sulfur at about 0.05% to about 0.07%, manganese at about 1.7 times the percentage of sulfur, plus about 0.3% to about 0.4%, and base iron chromium less than about 0.10%.

Claims 15-17,

> . . .preparing a molten grey iron metal for pouring that comprises a carbon equivalent of about 4.05% with about 3.40% to about 3.45% carbon and about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, base iron sulfur of about 0.05% to about 0.07%, manganese of about 1.7 times the percentage of sulfur, plus about 0.30% to about 0.40%, base iron chromium less than about 0.10%.

(See Section 3A in considering the portions of claim 9 that are included in claim 14.)

The Examiner argues, in part, that because the ranges of the elements of Tache et al.'s composition, and the ranges of the elements set forth in Applicant's claims overlap, this, in part, establishes the obviousness of Applicant's invention. While the composition used in Applicant's method is different, as acknowledged by the Examiner, Applicant will not contest in this appeal that the differences between the ranges of elements of the composition defined by his claims over the composition of elements disclosed in the Tache et al. patent at Col. 3, lines 41-49, by themselves, render the subject matter of claims 1-5 and 14-17 to be non-obvious.

The Examiner's rejection, however, further states,

> Preferably, the tin is added to the molten gray iron in the cupola during filling of the pouring ladles by addition of pre-weighed chunks of metallic tin in the range of 0.05 to 0.08% by weight, resulting in a molten alloy of tin with gray iron, followed by a subsequent (as soon as possible) casting into the molds to produce the engine components. (Col. 3, line 75; and Col. 4, lines 1-46).

With respect to this portion of the rejection, it is apparently directed at the following subject matter of Applicant's claims.

Claims 1-5,

> . . .transferring said molten controlled-content grey iron metal to a pouring ladle;
> alloying said molten controlled-content grey iron metal with tin in said pouring ladle to a total tin content of about 0.05% to about 0.10% to provide a molten, tin alloyed, controlled-content grey iron metal;
> * * *
> pouring said molten, tin alloyed, inoculated, controlled-content grey iron metal as soon as possible after said inoculation into a casting mold.

Claims 15-17,

> . . .transferring the molten grey-iron metal, absent tin, to a pouring ladle, adding tin to the molten grey iron metal in said pouring ladle to said content of about 0.05% to about 0.10%, . . .
> * * *
> . . .pouring the molten grey iron metal as soon as possible after said inoculation into a casting mold.

The omissions from the quoted portions of Applicant's claims that are indicated by asterisks above relate to the steps of inoculating the molten grey iron metal with an inoculant to a further silicon addition of about 0.10% to about 0.12%, which the Examiner acknowledges is not disclosed by Tache et al. Accordingly, the Examiner acknowledges that Tache et al. does not disclose Applicant's claimed invention as a whole, and, as a result, has cited Bostater et al., which is discussed further below.

Assuming *arguendo* that Tache et al. disclose the step of adding tin to the molten grey iron metal during the filling of the pouring ladles in percentages overlapping those recited in Applicant's claims, Applicant submits, however, that Tache et al. does not teach the steps of "pouring said molten, tin alloyed, inoculated, controlled-content metal as soon as possible after said inoculation into the casting mold . . ." in claims 1-5, or "casting an internal combustion engine part as soon as possible after said inoculation," in claim 14 (dependent from claim 9), or "pouring the molten grey iron metal as soon as possible after said inoculation into the casting mold," in claims 15-17.

In his rejection, the Examiner refers to Col. 3, line 75, through Col. 4, line 46, in support of this portion of his rejection. Applicant respectfully submits that there is no disclosure in Tache et al. at Col. 3, line 75, through Col. 4, line 46, of Applicant's claimed step of pouring the molten inoculated tin-alloyed grey iron metal, or casting an internal combustion engine part, as soon as possible after inoculation. Tache et al. contains no disclosure indicating that time is a factor that should be reduced following an inoculation of the molten, tin alloyed, controlled-

content grey iron metal because Tache et al., among other things, does not teach the inoculation of molten, tin alloyed, controlled-content grey iron metal to a further silicon addition of from about 0.1 to 0.12%. In addition, Tache et al.'s only disclosure regarding time involved in pouring is at Col. 1, lines 54-57, "The ladles are then transferred to the pouring line and the molds are filled at the prescribed temperature (2550°F to 2650°F) at a proper rate." The Tache et al. disclosure does not disclose that a molten, tin alloyed, controlled-content grey iron metal as claimed should be poured, or an internal combustion engine part should be cast, as soon as possible after inoculation.

The Examiner further comments in this regard as follows:

> Second, the limitation "as soon as possible" (as discussed on page 8 of applicant's remarks), when taken in view of a "pouring" step does not set forth an inventive step, nor is it even quantitative. Furthermore, if molten metal is not poured "as soon as possible" from a pouring ladle (most of which were unheated at the time of both prior art references in the 35 U.S.C. [sic] 103(a) rejection), there is an increased risk of oxide inclusions upon casting, as well as increased solidification of metal within the ladle, such that one of ordinary skill in the art would have recognized that pouring "as soon as possible" is an obvious course of action to take in practically any molten metal pouring process.

The Examiner's remarks, "the limitation 'as soon as possible,' . . . when taken in view of a 'pouring' step does not set forth an inventive step nor is it even quantitative," indicates that the Examiner has given "as soon as possible" no weight, and has not considered Applicant's invention as a whole. As indicated above, even indefinite claim limitations must be considered in considering the invention as a whole. (MPEP Section 2143.03).

In addition, the Examiner states,

> . . . Furthermore, if the molten metal is not poured "as soon as possible" from the pouring ladle (most of which were unheated at the time of both prior art references in the 35 U.S.C. [sic] 103(a) rejection), there is an increased risk of oxide inclusions upon casting, as well as increased solidification of metal within the ladle, such that one of ordinary skill in the art would have recognized that pouring "as soon as possible" is an obvious course of action to take in practically any molten metal pouring process.

Applicant submits that there is no evidence of record to support this statement of the Examiner. As set forth in MPEP Section 2144.03, Section A,

> It is never appropriate to rely solely on "common knowledge" in the art without evidentiary support in the record, as the principle evidence upon which a rejection is based. *Zurko*, 258 F.3d at 1385, 59 USPQ 2d at 1697 ("[T]he Board cannot simply reach a conclusion based on its own understanding or experience - or on its assessment of what would be a basic knowledge or common sense. Rather, the Board must point to some

> concrete evidence in the record in support of these findings.") (Page 2100-132, Rev. 1, Feb. 2003.)

> Further Bostater et al. teach that:
> A cardinal feature of the method of the present invention is that after the molten grey metal is made it is held at a substantially constant temperature for a period of from one and one-half to two and one-half hours prior to being poured into the molds." (column 2, lines 48-53)

Thus neither Tache et al. nor Bostater et al nor their combination teach this "as soon as possible" limitation. Indeed, Bostater et al. teach to the contrary.

Turning to the alloy composition, contrary to the Examiner's statement that ". . . tin is added to the molten grey iron in the cupola during filling of the pouring ladles by addition of pre-weighed chunks of metallic tin in the range of 0.05 to 0.08% by weight, resulting in a molten alloy of tin, followed by a subsequent (as soon as possible) casting into the molds to produce engines comments," Applicant's evidence is, "Tache et al. do not teach inoculation of a molten grey iron to a further silicon content of about 0.10% to about 0.12% silicon, pouring as soon as possible after inoculation and shaking out the casting while they are over 1400°F." (Applicant's Declaration, Tab 1, paragraph 4). As indicated above, neither Tache et al. nor Bostater et al. disclose or teach the combination of steps of Applicant's claims 1-5, 14 and 15-17 that have been considered above in Section 3A.

Furthermore, Applicant's claims 1-5, 14 and 15-17 are patentably distinguished from the cited references by the steps of "shaking out the resulting casting out of the casting mold while the temperature is over 1400°F;" in claims 1-5, "removing the cast part from its mold while in excess of 1400°F;" in claim 14 and "shaking out the resulting casting out of the casting mold while at a temperature of over 1400°F" in claims 15-17.

> In the final sentence of the Examiner's statements concerning Tache et al., he states,
> After the molten grey metal composition is poured into molds while the molten metal is at about 2550-2650°F, the resulting casting is cooled and taken to a core knockout and shakeout station while the bores are still at temperatures of about 1450-1500 degrees F (column 1, lines 55-70).

The portion referred to by the Examiner, column 1, lines 55-70, refers to operations <u>that existed prior to the Tache et al. invention</u> (e.g., with a non-tin alloy). Furthermore, Column 1, lines 55-70 state,

> The cope is then removed and the solidified casting is placed on a cooling line conveyor after gate removal. The castings are now at a temperature of about 1600°F. The castings continue to cool for about 1 1/4 hours until the core knockout station is reached. The exterior of the casting is now about 1100°F or less, and the bores are still at about 1450°F to 1500°F. The castings are sent over shakeout tables where the burned cores and remaining green sand are removed.

Contrary to the Examiner's statements, Tache et al. do not teach the hot shake-out steps of Applicant's claims 1-5 and 14-17. To the contrary, Tache et al. states that before castings are sent to shakeout their exteriors are about <u>1100°F</u>.

Bostater et al. contain no teaching relating to the hot shake out steps.

As set forth in paragraph 4 of Applicant's Declaration at Tab 1, ". . . Tache et al. do not teach inoculation of a molten grey iron to a further silicon content of about 0.10% to about 0.12% silicon, pouring as soon as possible after inoculation, and shaking out the castings while they are over 1400°F."

Thus, Tache et al. and Bostater et al. do not disclose, teach or suggest the invention of Applicant's claims 1-5, 14 and 15-17.

The molten, tin alloyed, controlled-content grey iron metal used in Applicant's claimed method is different from the alloy disclosed by Tache et al. Tache et al.'s alloy includes manganese in an amount of 0.5 to 0.9%; Applicant's teaching is to use manganese at about 1.7 times the percentage of sulfur, plus about 0.3 to about 0.4%. Tache et al. teach that phosphorus can be used up to 0.15% while Applicant's alloy contains <u>less</u> than about 0.03% phosphorus. Tache et al. teach that sulfur can be up to 0.12%, while in Applicant's alloy, sulfur is maintained at about 0.05 to about 0.07%, and Tache et al.'s alloy may have chromium of up to 0.15%, while in Applicant's alloy the chromium is <u>less</u> than 0.10%. While the differences between the alloy used in Applicant's claimed methods and the alloy taught by Tache et al. may not establish, in and of themselves, that Applicant's claimed methods are patentable, they must be considered in combination with the other differences between Applicant's claimed methods in considering the patentability of Applicant's invention as a whole.

As set forth in paragraph 4 of the Applicant's Declaration at Tab 1,

> The Tache patent does not teach our method. The Tache patent does not teach the use of low levels of carbide stabilizers, reduced casting times and hot casting shake out. To the contrary, Tache's castings remain in the molds such long times that Tache adds tin to stabilize the hardness of the casting, and Tache does not teach inoculation of a molten grey iron to a further silicon content of about 0.10% to about 0.12% silicon and pouring

> as soon as possible after inoculation, and shaking out the castings while they are over 1400°F. In addition, Tache uses high levels of chromium and phosphorus, both of which promote hard spots in castings.

While Tache et al. disclose alloying their gray iron alloy (which is different than Applicant's alloy) with tin, in the preferable amount of 0.05% to 0.08%, Tache et al. do not disclose the combined steps of inoculating the molten tin-alloyed controlled content gray iron metal with a gray iron inoculant to a further silicon addition of from about 0.10% to about 0.12% of silicon, pouring the molten tin-alloyed, inoculated controlled content gray iron metal into a casting mold, or casting an internal combustion engine part, as soon as possible after the inoculation, and shaking out the resulting castings, or removing the cast part form its mold, at temperatures over 1400°F.

As set forth above, Tache et al. contains <u>no</u> disclosure indicating that time is a factor that should be reduced following the inoculation of the molten tin-alloyed controlled content grey iron metal because Tache et al.'s only disclosure regarding the time involved in pouring is at column 1, lines 54-57, "The ladles are then transferred to the pouring line and the molds are filled at the prescribed temperature (2550°F to 2650°F) at a proper rate." The Tache et al. disclosure does not teach or suggest that a molten tin-alloyed, inoculated controlled content gray iron metal as claimed should be poured as soon as possible after inoculation.

Furthermore, the problem that motivated Tache et al. in their invention was different than the motivation for Applicant's invention. Tache et al. state, for example, in describing the results of a casting with the composition set forth at column 2, lines 16-25, which does not contain any alloying tin, "...repeated field complaints of a high incidence of bore wear and oil consumption on engines revealed on investigation that the bores were quite soft, as low as 110 Brinell and had a microstructure unsuitable for the type of service to which the castings were to be subjected." (column 2, lines 26-32). Tache et al. further state,

> Further investigation showed that most of the soft blocks were either the result of normal shutdown of the foundry molding and cooling line conveyors described above such as for lunch hour, shift changes, or overnight stoppage, or due to unforeseeable line stoppages because of equipment failures. In each of these instances the castings were retained for extended periods in the molds or on the cooling conveyors prior to core knock-out. Such permitted the bores to self-anneal because of the slow cooling rate through the secondary graphitizing range of approximately 1450°F to 1200°F. (column 2, lines 38-48).

Tache et al.'s solution to this problem was

> ...to treat or modify the gray iron composition to stabilize the microstructure during the periods of slow cooling to minimize the production of soft bores and poor wearing surfaces on the castings. In this connection, it had been found that these soft castings were evidenced by the formation of substantial amounts of free ferrite and that control of this action, if possible, could be beneficial. (column 2, lines 61-68).

Tache et al. further state,

> ...it was found that if tin in certain critical quantities in the range of 0.04 to 0.10 was used in gray iron compositions of the above general character, that it was possible to obtain satisfactory castings substantially free of soft bores and having high wear resistant surfaces by the normal production methods that had previously caused the above described difficulties when normal or abnormal stoppages occurred in the casting line. (column 3, lines 18-26).

On the other hand, Applicant's invention of claims 1-5 and 14-17 sought an economical method for manufacturing gray iron crank cases and cylinder heads having minimal iron carbide hard spots and chills upon solidification, minimal need for stress relief treatment of the finished casting and shortened cooling times, through hot shake-out temperatures. See Applicant's specification, page 2, lines 5-9. As a result of Applicant's invention, this method of manufacture uses a molten gray iron metal that has, compared with prior manufacturing methods, substantially increased carbon levels, lower levels of phosphorus, significantly lower levels of chromium, somewhat lower levels of sulfur, which, with the alloying use of tin as a pearlite stabilizer, substantially reduces the potential for carbide hard spots and chills and allows significantly reduced silicon content in the gray iron and minimal inoculation additions while achieving higher shake-out temperatures and providing castings with lower residual stresses. See Applicant's specification, page 2, lines 23-29, and paragraphs 3 and 4 of Applicant's Declaration, at Tab 1.

As indicated above, Tache et al. disclose the use of phosphorus up to 0.15%, five times the level of phosphorus used in Applicant's method; Tache et al. disclose the use of chromium up to 0.15%, one and one-half times the level of chromium used in Applicant's method, and Tache et al. do not disclose an inoculation of his alloy to a level of 0.10% to about 0.12% silicon, pouring the inoculated molten metal as soon as possible after inoculation and shaking out castings at temperatures in excess of 1400°F.

The Examiner has cited Bostater et al., U.S. Patent No. 4,493,359, as disclosing the inoculation steps of Applicant's claims that are acknowledged by the Examiner to be missing

from the teachings of Tache et al. Bostater et al. has no disclosure, teaching or suggestion of the use of the alloy used in Applicant's claimed methods and no disclosure, teaching or suggestion of the use of tin, whatsoever, and no disclosure, teaching or suggestion of shaking a resulting casting out of the casting mold, or removing a cast part from its mold, at temperatures in excess of 1400ºF. The Examiner's reliance on Bostater et al. ignores the teachings of Bostater et al. that are contrary to Applicant's claimed invention.

The combination of Tache et al. and Bostater et al., U.S. Patent No. 4,493,359, fails to disclose, teach or suggest Applicant's invention. Tache et al. and Bostater et al. have disparate disclosures and would not be combined by one of ordinary skill in the art as the Examiner has combined them. The Examiner's combination of Tache et al. and Bostater et al. can only be the result of his <u>hindsight</u> view of the references, resulting from Applicant's invention.

As set forth in paragraph 6 of Applicant's declaration,

> I do not believe the combined teachings of the Tache et al. patent and Bostater et al. patent teach our casting method. The combined teachings of the Tache et al. and Bostater et al. patents do not teach a casting method in which a molten grey iron with very low levels of carbide stabilizers and a low level of tin is inoculated with silicon to a level of about 0.10% to about 0.12%, is poured as soon as possible after inoculation, and in which the resulting castings are removed from the molds at over 1400°F. Furthermore, I do not believe a skilled metallurgist, trying to develop castings with high strength, minimal iron carbide hard spots and chills, low residual stresses in reduced casting times and without additional equipment, would combine the teachings of the Tache patent and the Bostater et al. patent, whose teachings are directed to different problems.

The problem with which Bostater et al. were concerned is described, for example, as follows,

> "By far most of the defects occur in the thinnest wall portions of the castings, and the thinner the walls, the greater the scrap loss. At present, a scrap loss of about five percent in the casting operation is accepted by the industry as being nominal for engine blocks wherein the minimum wall thickness is about 0.180 inches. For engine blocks having substantially smaller wall thicknesses, for example, 0.150 inches, there is a dramatic increase in scrap loss, typically to as high as twenty-five percent. Such scrap losses are prohibitive as regards the manufacture of engine blocks for high production automobiles and trucks, and hence it is currently the practice of the automotive industry to design all high-production engines to have engine block wall thicknesses of at least 0.180 inches. It is this limitation on the design of engine blocks that has become an ever-increasing problem in the attainment of lesser gross vehicle weight.
>
> The present invention solves this problem by providing a method whereby cast iron engine blocks can be made with wall thicknesses substantially less than are now used, without any increase in scrap loss...A cardinal feature of the method of the present invention is that after the molten grey metal is made it is held at a substantially constant

temperature for a period of from one and one-half to two and one-half hours prior to being poured into the molds." (column 2, lines 23-53).

Bostater et al. also state,

Because the temperature in the molten metal in the holding furnace is maintained substantially constant, during the lengthy residence time of the molten metal in the holding furnace there is attained not only an increase in homogeneity of the metal composition but also an increase in the uniformity of the temperature of the molten metal throughout its mass. The increased uniformity in composition and the increased uniformity in temperature are important not only in and of themselves but also important in better assuring a constancy in the fluidity of the molten metal. With this increased uniformity in composition, temperature and fluidity, the flow and the cooling of the molten metal poured into the mold are of an improved, controlled uniformity. (column 3, lines 3-18).

Bostater et al. further state that in their invention,

The metal formulation can be any of those well known in the art for machinable grey cast iron, preferably having a chemistry as poured, which includes, by weight, from 3.30% to 3.60% C, from 2.10% to 2.65% Si, from 0.05% to 0.09% P, from 0.5% to 0.7% Mn, from 0.15% to 0.25% Cr, from 0.1% to 0.15% Ni, and from 0.15% to 0.25% Cu, 0.15% maximum S and the remainder Fe. (column 3, lines 51-59).

This metal formulation <u>is devoid of tin</u> and is different from both Tache et al.'s metal alloy and the alloy used in Applicant's invention. Bostater et al. disclose an alloy having substantially higher values of silicon, phosphorus and chromium than those used in Applicant's method, and unlike Applicant's method, Bostater et al. disclose the use of quantities of nickel and copper, and the use of manganese in an amount equal to 0.61%.

Bostater et al. do disclose the inoculation of their alloy with a ferrosilicon inoculant; however, Bostater et al. do not disclose Applicant's steps of inoculating Applicant's molten tin-alloyed, controlled content gray iron metal with an inoculant to further the silicon addition of from about 0.10% to about 0.12% and removing the castings from the molds while they are over 1400°F.

Bostater et al. are interested only in obtaining molten metal with sufficient fluidity to reliably form walls having a thickness of about 0.150 inches. Unlike Applicant's invention, Bostater et al. do not disclose a concern with minimizing iron carbide hot spots and chills upon solidification, minimizing the need for stress relief heat treatment of the finished castings, or minimizing cooling times, by obtaining hot shake-out temperatures. Unlike Applicant's method of manufacture, Bostater et al. do not disclose or teach lower levels of phosphorus, significantly lower levels of chromium, somewhat lower levels of sulfur and the alloying use of tin as a

pearlite stabilizer to substantially reduce the potential for iron carbide hot spots and chills, and do not teach a significantly reduced silicon content and minimal inoculate additions. Contrary to Applicant's invention, Bostater et al. teach the use of expensive alloying agents copper and nickel that are no part of Applicant's invention.

Paragraph 3 of Applicant's Declaration states:

"In our method, very low levels of carbide stabilizers, such as chromium and phosphorus, and a very low level of tin, are used in molten grey iron casting metal, which is inoculated with silicon to a level of about 0.10% to about 0.12% while it is in the pouring ladle, and poured as soon as possible after inoculation, and the castings are shaken out while hot, in excess of 1400°F."

Even if Tache et al. and Bostater et al. were combinable, which is contrary to Applicant's Declaration, their combined teachings would, contrary to the invention, provide an alloy with about twice the percentage of the carbide stabilizer phosphorus, about one hundred fifty percent of the carbide stabilizer chromium that are used in Applicant's method, and would further include 0.15% to 0.25% nickel and 0.15% to 0.25% copper. Such teachings are contrary to the invention and Applicant's use of "very low levels of carbide stabilizers," and cannot be ignored.

Furthermore, Applicant's invention requires no additional processing equipment, however, as stated by Bostater et al., "Further, in accordance with the preferred embodiment, this is accomplished by the use of <u>a holding furnace of massively increased capacity</u>, as compared to the holding furnaces heretofore used." (column 2, lines 52-56). (Emphasis Added).

Thus, one of ordinary skill in the art would not combine the teachings of Bostater et al. with those of Tache et al., and in any event, their combination would not achieve the results sought by Applicant by the invention of claims 1-5 and 14-17, i.e., an economical method of manufacturing grey iron castings with minimal iron carbide hotspots and chills, minimal need for stress relief, a requirement of no additional processing equipment and reduction of production time achieved by shake-out at temperatures over 1400°F.

Applicant respectfully submits that Tache et al. and Bostater et al. do not disclose, teach or suggest the invention claimed in claims 1-5 and 14-17 and respectfully submits that the Examiner's rejection be overturned.

<u>3C. THE REJECTION OF DEPENDENT CLAIMS 3-5, 11-13 AND 17 HAS NOT BEEN SUPPORTED BY THE EXAMINER AND THE SUBJECT MATTER OF CLAIMS 3-5, 11-13, 16 AND 17 WERE NOT OBVIOUS IN VIEW OF THE CITED REFERENCES</u>

Claims 3-5, 11-13, 16 and 17 are not only patentable because of their dependence from claims 1, 9 and 15, but because their claimed subject matters are not disclosed, taught or suggested in the cited references.

Applicant can identify no portion of the Examiner's rejection and action that is specific to claimed subject matter of the Applicant's dependent claims 3-5, 11-13, 16 and 17. With no express rejection, claims 3-5, 11-13, 16 and 17 should be allowed.

In any event, the subject matters of dependent claims 3-5, 11-13, 16 and 17 are not obvious in view of the cited references Tache et al. and Bostater et al. To the contrary, the teachings of the Examiner's primary references are contrary to the invention of claims 3-5, 11-13, 16 and 17.

Dependent claims 3-5, and claims 11-13 recite the method of claim 1 and of claim 9, respectively:

> "wherein the molten controlled-content grey iron metal is alloyed with tin in a percentage dependent on important section of the part being cast that is required to have greatest strength and/or machinability."

Tache et al. fails to disclose, teach or suggest, and, if anything, teaches away from, the subject matter of claims 3-5, and 11-13. Tache et al. states,

> "The amount of tin to use in this range (apparently referring to the range 0.04 to 0.10 set forth at Col. 3, line 19) <u>was dependent upon the carbon equivalent (carbon plus one third silicon) the amount increasing with increased carbon equivalency." (Col. 3, lines 29-32</u>). (Emphasis added.)

> "When tin is used in amounts less than .04%, adequate protection against self-anneal during periods of line cessation and breakdown become questionable and the ferritic content substantially exceeds the 5% minimum. Hence, at least .04% is essential and .05% is preferable for consistent results as noted above. Between .05% to .08% is found adequate for normal production operations with compositions within the limits set forth above. In special cases, 0.04 to 0.10% may be employed. Tin, in an amount above .10% may be used but does not add anything to improve the microstructure of the castings and is found to be economically unjustified. Amounts in excess of 0.25 will result in loss of tensile and impact strength." (Col. 4, lines 9-22).

Thus, Tache et al. fail to disclose, teach or suggest the subject matter of claims 3-5 and 11-13, but teach instead that "the amount of tin used in this range <u>was dependent upon the carbon equivalent</u>."

Bostater et al. has no disclosure, teaching or suggestion of the use of tin whatsoever.

Further, claims 4, 12 and 16 are further patentably distinguished from Tache et al. and Bostater et al. by their recitations.

Claims 4 and 12, which depend from allowable claims 3 and 11, respectively, further recite,

> . . . wherein the molten, controlled-content grey iron metal is alloyed with tin at the high end of the percentage range for parts with an important section that cools slowly."

Claim 16, which depends from allowable claim 15, further recites,

> . . .wherein the resulting casting includes an important section that cools slowly and the molten grey iron metal, when poured, has a total tin content of about 0.10%.

As indicated above, neither Tache et al. nor Bostater et al., nor their combination, discloses, teaches or suggests the claimed subject matters of claims 4, 12 or 16. Only Tache et al. teach a use of tin and their teaching is that the amount of tin to be used depends on the carbon equivalency.

Still further, claims 5, 13 and 17 are also further patentably distinguished from Tache et al. and Bostater et al. by their recitations.

Claims 5 and 13 depend from allowable claims 3 and 11, respectively, and further recite,

> . . .wherein the molten controlled-content grey iron metal is alloyed with tin at the low end of the percentage range for parts with an important section that cools quickly.

Claim 17, which depends from allowable claim 15, further recites,

> . . .wherein the resulting casting includes an important section that cools quickly and the molten grey iron metal, when poured, has a total tin content of about 0.05%.

As indicated above, neither Tache et al. nor Bostater et al., nor their combination, discloses, teaches or suggests the claimed subject matter of claims 5, 13 or 17. Only Tache et al. teach a use of tin and that teaching is that the amount of tin to be used depends on the carbon equivalency.

Claims 3-5, 11-13, 16 and 17 have not been specifically rejected by the Examiner, and, in any event, their subject matters were not obvious in view of the cited references. Accordingly, claims 3-5, 11-13, 16 and 17 should be allowed.

CONCLUSION

The Examiner's rejection should be reversed for the reasons set forth above. Accordingly, claims 1 - 5 and 9 -15 should be allowed.

Respectfully submitted,

Dennis K. Sullivan
Registration No. 26,510

Warrenville, Illinois
Date: August 14, 2003
Telephone: (630) 753 2311

Certificate Under 37 CFR 1.8(a)

I hereby certify that this correspondence is being deposited with with the United States Postal Service with sufficient postage as first-class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on August 12, 2003.

PATENT
Our Case No. D5216

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	Group Art Unit 1725
Joseph R. Ward et al.	Examiner: Kevin P. Kerns
Serial No.: 10/027,071	
Filed: December 20, 2001	
For: METHOD FOR MANUFACTURE OF GREY CAST IRON FOR CRANKCASES AND CYLINDER HEADS	

DECLARATION OF JOSEPH R. WARD PURSUANT TO 37 C.F.R. §1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

1. I, Joseph R. Ward, am one of the inventors of this patent application. I graduated from the University of Missouri in 1972 with a Bachelor of Science degree in Metallurgical Engineering. I have worked with metallurgy and casting operations for over 31 years, and I am currently employed with the Indianapolis Casting Corporation with the title of Metallurgist. The Indianapolis Casting Corporation is a wholly owned subsidiary of the International Truck and Engine Corporation, which is the operating entity of Navistar International.

2. I have been given and have studied U.S. Patent No. 3,299,482, issued to Mr. Tache, and U.S. Patent No. 4,493,354, issued to Messrs. Bostater, MacGregar and Gesicki.

These patents, I understand, have been identified by the Patent Examiner as indicating that the invention of this patent application is not patentable.

3. The invention of this patent application is a method of casting with a grey iron that is not taught by the Tache and Bostater et al. patents. In our method, very low levels of carbide stabilizers, such as chromium and phosphorus, and a low level of tin are used in a molten grey iron casting metal, which is inoculated with silicon to a level of about 0.10% to about 0.12% while it is in the pouring ladle, and poured as soon as possible after inoculation, and the castings are shaken out while they are hot, in excess of 1400°F. Our invention provides castings with high strength and minimal iron carbide hard spots and chills, low residual stresses in reduced casting times and without additional equipment.

4. The Tache patent does not teach our method. The Tache patent does not teach the use of low levels of carbide stabilizers, reduced casting times and hot casting shake out. To the contrary, Tache's castings remain in the molds such long times that Tache adds tin to stabilize the hardness of the casting, and Tache does not teach inoculation of a molten grey iron to a further silicon content of about 0.10% to about 0.12% silicon, pouring as soon as possible after inoculation, and shaking out the castings while they are over 1400°F. In addition, Tache uses high levels of chromium and phosphorus, both of which promote hard spots in castings.

5. The Bostater et al. patent is also not significant to our invention. It appears that the Examiner has referred to the Bostater et al. patent only because it discloses inoculation of a grey iron metal with a ferrosilicon inoculant. Inoculation with silicon containing inoculants has been done for years and is a common foundry practice. However, in the method of our invention, molten grey iron casting metal with very low levels of carbide stabilizers and tin, is inoculated to provide a further silicon addition of 0.10% to 0.12% by weight, is poured into the molds as soon as possible after inoculation, and the resulting castings are shaken out of the mold while they are over 1400°F. The Bostater et al. patent does not teach these steps. The Bostater et al. patent is concerned with obtaining fluidity of the molten casting metal by maintaining it in a holding furnace for at least one and one half hours so the molten metal will satisfactorily form thin walls in an engine block casting. Unlike our invention, which requires no new equipment, the Bostater et al. patent also indicates that its disclosed process requires a holding furnace of massively increased capacity.

6. I do not believe the combined teachings of the Tache patent and Bostater et al. patent teach our casting method. The combined teachings of the Tache and Bostater et al. patents do not teach a casting method in which a molten grey iron with very low levels of carbide stabilizers and a low level of tin is inoculated with silicon to a level of about 0.10% to about 0.12%, is poured as soon as possible after inoculation, and in which the resulting castings are removed from the molds at over 1400°F. Furthermore, I do not believe a skilled metallurgist, trying to develop castings with high strength, minimal iron carbide hard spots and chills, low residual stresses in reduced casting times and without additional equipment, would combine the teachings of the Tache patent and the Bostater et al. patent, whose teachings are directed to different problems.

Joseph R. Ward further declares that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application and patent resulting therefrom.

Declared at INDIANAPOLIS IN, this 13th day of AUGUST, 2003.

Dated: 08/13/03

Joseph R. Ward
(Signature)

Printed: Joseph R. Ward

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/027,071	12/20/2001	Joseph R. Ward	D5216	9833

30409 7590 10/17/2003

INTERNATIONAL ENGINE INTELLECTUAL PROPERTY COMPANY
4201 WINFIELD ROAD
P.O. BOX 1488
WARRENVILLE, IL 60555

EXAMINER	
KERNS, KEVIN P	
ART UNIT	**PAPER NUMBER**
1725	

DATE MAILED: 10/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/027,071	WARD, JOSEPH R.	
	Examiner	Art Unit	
	Kevin P. Kerns	1725	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 August 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 9-14* is/are pending in the application.

4a) Of the above claim(s) *6-8* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5 and 9-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-14* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. This application contains claims 6-8 drawn to an invention non-elected with traverse. The applicant is referred to paragraph 1 of the prior Office Action, regarding the choice of consecutive and simultaneous steps, as well as resulting elemental composition of the substantially similar gray cast iron product to be cast. In addition, as set forth in the election/restriction Office Action, an additional search burden would be placed on the examiner (class 164 method and class 123 product). Regarding the applicant's arguments, the examiner is not required to show "facts" or "evidence" in a restriction requirement, since only proper distinction of the inventions is required. Since the product having the specified ranges of elemental compositions can be made with either a single addition step or two addition steps, a proper restriction has been established. The requirement is still deemed proper and is therefore made FINAL. A complete reply to the final rejection must include cancellation of non-elected claims or other appropriate action (37 CFR 1.144). See MPEP § 821.01.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 1-5 and 9-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tache (US 3,299,482) in view of Bostater et al. (US 4,493,359).

Tache discloses a gray iron casting process and composition for making engine component parts by adding a tin alloying element, in which the composition includes (by weight percent): 3.05 to 3.45% carbon (carbon equivalent between 3.76 and 4.15%), 1.7 to 2.1% silicon, maximum 0.15% phosphorus, maximum 0.12% sulfur, 0.5 to 0.9% manganese, maximum 0.15% chromium, 0.05 to 0.08% tin, and balance iron (column 1, lines 11-16; column 3, lines 1-56 and 70-76; and column 4, lines 1-46). Preferably, the tin is added to the molten gray iron in the cupola during filling of the pouring ladles by addition of preweighed chunks of metallic tin in the range of 0.05 to 0.08% by weight, resulting in a molten alloy of tin with gray iron, followed by subsequent (as soon as possible) casting into mold(s) to produce the engine components (column 3, line 75; and column 4, lines 1-46). <u>After the molten gray iron composition is poured into molds while the molten metal is at about 2550 to 2650 degrees F, the resulting casting is cooled and taken to core knockout and shakeout stations while the bores are still at temperatures of about 1450-1500 degrees F (column 1, lines 55-70).</u> Although Tache

discloses a composition that includes silicon within the gray iron alloy, Tache does not disclose the step of adding further silicon as an inoculant to the molten gray iron alloy.

However, Bostater et al. disclose a method for making cast iron engine blocks from a casting process with molten gray iron, in which a silicon-containing inoculant (foundry grade ferrosilicon containing 23% iron and 7.5% silicon, ranging from 100 to 300 ounces of inoculant per 1,600 pounds of molten metal) is added to a molten gray iron composition (that already contains silicon) and stirred within a casting ladle for subsequent pouring into casting molds (abstract; column 1, lines 6-13; column 3, lines 3-21 and 52-68; column 4, lines 1-3 and 50-60; column 5, lines 54-68; column 6, lines 1-15; column 7, lines 4-26; and Figure). A sample of molten metal in the holding furnace was taken periodically for thermal analysis to obtain control of the carbon equivalent value (at a desired level of about 4%) within the molten gray iron (column 5, lines 42-53; and Figure). Castings of various cross-sections, including those that have very thin walls which would otherwise have high casting scrap losses, are able to be produced due to the molten metal homogeneity and addition of silicon-containing inoculant, with the advantageous feature of achieving a low casting scrap rate of less than 5% (column 2, lines 21-45; column 3, lines 3-21 and 33-40; column 4, lines 44-65; column 5, lines 54-68; column 6, lines 1-15; and column 7, lines 23-39). The additional step of adding a silicon-containing inoculant is advantageous for producing gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (column 4, lines 44-49; column 5, lines 57-68; column 6, lines 1-15; and column 7, lines 23-40).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the gray iron casting process and composition for making engine component parts by adding a tin alloying element, as disclosed by Tache, by using the additional step of adding and stirring a silicon-containing inoculant to a molten gray iron composition that already includes silicon, as taught by Bostater et al., in order to produce gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (Bostater et al.; column 4, lines 44-49; column 5, lines 57-68; column 6, lines 1-15; and column 7, lines 23-40).

Response to Arguments

5. The examiner acknowledges the applicant's amendment received by the USPTO by facsimile on August 14, 2003. The applicant continues to traverse the restriction requirement, and the examiner continues to disagree, as discussed in paragraph 1 above and in the prior Office Action (paper #6) of May 21, 2003. The applicant's amendment overcomes the prior claim objections and rejections under 35 USC 112, 2nd paragraph. The examiner also acknowledges the inventor's declaration under 37 CFR 1.132 in the amendment of August 14, 2003. Claims 6-8 are drawn to a non-elected invention and remain withdrawn from consideration. New claim 14 has been added, such that claims 1-5 and 9-14 are now under consideration in the application.

6. Applicant's arguments filed August 14, 2003 have been fully considered but they are not persuasive.

With regard to the applicant's arguments on pages 7-12 of the amendment, as well as the declaration under 37 USC 1.132, the examiner has considered the major issues as follows:

1) regarding the disclosure of Tache, as discussed by the applicant on pages 7-9, the examiner respectfully disagrees with the applicant's assertion that some of the ranges of elemental compositions (within the gray iron casting composition) cited in Tache do not correspond to the applicant's compositions. In fact, the examiner cannot find a single element in the overall composition that <u>does not fall within the ranges</u> required by applicants. Moreover, for any of Tache's elemental compositions that cite a "maximum" value, a minimum of 0% (inclusive of phosphorus, sulfur, and chromium, as the applicant argues near the bottom of page 7) also reads on the applicant's claims in the broadest reasonable interpretation. The amount of tin (0.05 to 0.08%) added to the gray iron composition is also disclosed in Tache, substantially overlapping with the applicant's tin range of (0.05 to 0.10%).

The exact amounts of each of the constituents as presently claimed are not disclosed in the prior art; however, the prior art compositions closely approximate or overlap applicant's claimed composition. It has been held that one of ordinary skill in the art at the time of the invention would have considered the claimed compositions to have been obvious because overlapping ranges in a composition is considered to establish a prima facie case of obviousness. See <u>In re Malagari</u> 182 USPQ 549, <u>Titanium Metals v. Banner</u> 227 USPQ 773, <u>In re Nehrenberg</u> 126 USPQ 383.;

2) on pages 8 and 9, the applicant (in both the amendment and declaration) has argued that the term "as soon as possible" is a significant feature in the claims. However, Tache would also be concerned with casting production time, and his operation is limited by cooling time of the cast product, as the gray iron composition must cool over 1000 degrees F before core knockout/shakeout (see new underlined portion of paragraph 4 above, which sets forth the response to new limitations in claims 1 and 14 of the applicant's amendment). In the casting operation, Tache would fill the mold at about 2600 F and cool the casting until the core temperature is at about 1500 F. In casting operations, the term "as soon as possible" is not only applicable to time, but also to temperature. Cooling the casting to a temperature of, for example, 1600 or 1800 degrees F could also be considered "as soon as possible", but optimum casting results may not be achieved. The same could be said over a wide range of temperatures spanning hundreds of degrees F. Therefore, casting results obtained by Tache is constrained by both time and temperature factors, and this is true in a plethora of casting operations in view of one of ordinary skill in the casting art; and

3) on pages 10-12, the applicant has argued that the disclosure of Bostater et al. does not provide a proper obviousness-type combination with Tache under 35 USC 103(a), even though Tache lacks only the silicon addition to the tin-alloyed gray iron metal. The examiner respectfully disagrees, as Bostater et al. disclose that ferrosilicon is added as the form of silicon (within the span of ranges) to gray iron, and the applicant also states that silicon is a common foundry inoculant in his declaration on paragraph 5, as well as the amendment near the bottom of page 10. The applicant also argues (on

pages 11 and 12) that the individual elemental compositions of Bostater et al. vary substantially from that of Tache and the applicant. Although some elements within the composition fall somewhat outside of the ranges of the applicant and Tache, the significant step of adding silicon to a gray iron composition already containing silicon is clearly set forth by Bostater et al., for the purpose of producing gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (see paragraph 4 above).

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kevin P. Kerns whose telephone number is (703)

305-3472. The examiner can normally be reached on Monday-Friday from 8:00am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Dunn can be reached on (703) 308-3318. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

KPK
kpk
October 6, 2003

..XANDRA ELVE
..IMARY EXAMINER

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/027,071	12/20/2001	Joseph R. Ward	D5216	9833

30409 7590 08/12/2004

INTERNATIONAL ENGINE INTELLECTUAL PROPERTY COMPANY
4201 WINFIELD ROAD
P.O. BOX 1488
WARRENVILLE, IL 60555

EXAMINER	
KERNS, KEVIN P	

ART UNIT	PAPER NUMBER
1725	

DATE MAILED: 08/12/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/027,071	WARD, JOSEPH R.
	Examiner	Art Unit
	Kevin P. Kerns	1725

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 July 2004*.

2a)☒ This action is FINAL. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 9-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5 and 9-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____

39). The additional step of adding a silicon-containing inoculant is advantageous for producing gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (column 4, lines 44-49; column 5, lines 57-68; column 6, lines 1-15; and column 7, lines 23-40).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the gray iron casting process and composition for making engine component parts by adding a tin alloying element, as disclosed by Tache et al., by using the additional step of adding and stirring a silicon-containing inoculant to a molten gray iron composition that already includes silicon, as taught by Bostater et al., in order to produce gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (Bostater et al.; column 4, lines 44-49; column 5, lines 57-68; column 6, lines 1-15; and column 7, lines 23-40).

Response to Arguments

3. The examiner acknowledges the applicant's amendment received by the USPTO on July 26, 2004. The prior objection to claim 16 has been overcome by the applicant's amendment. Claims 1-5 and 9-17 remain under consideration in the application.

4. Applicant's arguments filed July 26, 2004 have been fully considered but they are not persuasive.

With regard to the applicant's arguments on pages 7-13 of the amendment/remarks, as well as its reference to the inventor's declaration under 37 USC 1.132, the examiner has previously addressed several critical issues (that the applicant also currently presents) in the final rejection mailed October 17, 2003, the advisory action mailed January 27, 2004, and the prior non-final Office Action mailed April 26, 2004. Additional comments to the currently presented applicant's remarks are as follows:

First, the applicant's amendments to the claim language ("consisting of" (claim 1) and "consists essentially of" (claim 15), which have been changed to "comprising" and "comprises", respectively) essentially revert to the previous "open-ended" claim language, for which arguments have been set forth in the prior Office Actions that address the open-ended "comprising" and "comprises" claim language.

Second, the limitation "as soon as possible" (as discussed on page 8 of applicant's remarks), when taken in view of a "pouring" step, does not set forth an inventive step, nor is it even quantitative. Furthermore, if molten metal is not poured "as soon as possible" from a pouring ladle (most of which were unheated at the time of both prior art references in the 35 USC 103(a) rejection), there is increased risk of oxide inclusions upon casting, as well as increased solidification of metal within the ladle, such that one of ordinary skill in the art would have recognized that pouring "as soon as possible" is an obvious course of action to take in practically any molten metal pouring process.

Third, the applicant (on pages 7 and 8 of the remarks) continues to argue about the comparative ranges of the elemental compositions. Regarding the ranges of elemental compositions (within the gray iron casting composition) cited in Tache et al., the applicant is citing phosphorus, sulfur, and chromium as examples on pages 7 and 8 of the remarks. However, all of these elements have ranges that overlap. For example, when Tache's chromium has a composition up to 0.15%, then 0% is inclusive of such a range, which is also less than the 0.1% disclosed by the applicant. It is respectfully asserted that the Tache et al. reference only lacks the step of silicon addition to the tin-alloyed gray iron metal. This concept is clearly taught by Bostater et al., and is deemed to cure the deficiencies of Tache et al. under 35 USC 103(a), as the significant step of adding silicon to a gray iron composition already containing silicon is clearly set forth by Bostater et al., for the purpose of producing gray iron castings of various cross-sections with a substantial increase in the uniformity of molten metal as poured (see paragraph 2 above).

5. In response to applicant's argument (on page 10 of the remarks) that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge

gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kevin P. Kerns whose telephone number is (571) 272-1178. The examiner can normally be reached on Monday-Friday from 8:00am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Dunn can be reached on (571) 272-1171. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Kevin P. Kerns
Examiner
Art Unit 1725

KPK
kpk
August 8, 2004

KILEY S. STONER
PRIMARY EXAMINER
Kiley Stoner 8/10/04

poured into molds while the molten metal is at about 2550 to 2650 degrees F, the resulting casting is cooled and taken to core knockout and shakeout stations while the bores are still at temperatures of about 1450-1500 degrees F (column 1, lines 55-70). Although Tache et al. disclose a composition that includes silicon within the gray iron alloy, Tache et al. do not disclose the step of adding further silicon as an inoculant to the molten gray iron alloy.

However, Bostater et al. disclose a method for making cast iron engine blocks from a casting process with molten gray iron, in which a silicon-containing inoculant (foundry grade ferrosilicon containing 23% iron and 7.5% silicon, ranging from 100 to 300 ounces of inoculant per 1,600 pounds of molten metal) is added to a molten gray iron composition (that already contains silicon) and stirred within a casting ladle for subsequent pouring into casting molds (abstract; column 1, lines 6-13; column 3, lines 3-21 and 52-68; column 4, lines 1-3 and 50-60; column 5, lines 54-68; column 6, lines 1-15; column 7, lines 4-26; and Figure). A sample of molten metal in the holding furnace was taken periodically for thermal analysis to obtain control of the carbon equivalent value (at a desired level of about 4%) within the molten gray iron (column 5, lines 42-53; and Figure). Castings of various cross-sections, including those that have very thin walls which would otherwise have high casting scrap losses, are able to be produced due to the molten metal homogeneity and addition of silicon-containing inoculant, with the advantageous feature of achieving a low casting scrap rate of less than 5% (column 2, lines 21-45; column 3, lines 3-21 and 33-40; column 4, lines 44-65; column 5, lines 54-68; column 6, lines 1-15; and column 7, lines 23-

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-5 and 9-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tache et al. (US 3,299,482) in view of Bostater et al. (US 4,493,359).

Tache et al. disclose a gray iron casting process and composition for making engine component parts by adding a tin alloying element, in which the composition includes (by weight percent): 3.05 to 3.45% carbon (carbon equivalent between 3.76 and 4.15%), 1.7 to 2.1% silicon, maximum 0.15% phosphorus, maximum 0.12% sulfur, 0.5 to 0.9% manganese, maximum 0.15% chromium, 0.05 to 0.08% tin, and balance iron (column 1, lines 11-16; column 3, lines 1-56 and 70-76; and column 4, lines 1-46). Preferably, the tin is added to the molten gray iron in the cupola during filling of the pouring ladles by addition of preweighed chunks of metallic tin in the range of 0.05 to 0.08% by weight, resulting in a molten alloy of tin with gray iron, followed by subsequent (as soon as possible) casting into mold(s) to produce the engine components (column 3, line 75; and column 4, lines 1-46). After the molten gray iron composition is

CLAIMS APPENDIX

1. A method for the manufacture of crank cases and cylinder heads from grey cast iron comprising the steps of:

providing a molten controlled-content grey iron metal having a carbon equivalent of about 4.05%, comprised of about 3.40% to about 3.45% carbon, about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, while maintaining base iron sulfur at about 0.05% to about 0.07%, manganese at about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium less than about 0.10%;

transferring said molten controlled-content grey iron metal to a pouring ladle;

alloying said molten controlled-content grey iron metal with tin in said pouring ladle to a total tin content of about 0.05% to about 0.10% to provide a molten tin-alloyed, controlled-content grey iron metal;

inoculating said molten tin-alloyed, controlled-content grey iron metal with a grey iron inoculant to a further silicon addition of from about 0.10% to about 0.12%;

pouring said molten, tin-alloyed, inoculated controlled-content grey iron metal as soon as possible after said inoculation into a casting mold; and

shaking out the resulting casting out of the casting mold while at a temperature over 1400°F.

2. The method of claim 1 wherein the step of providing the molten controlled content grey iron metal comprises determining the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of scrap steel, grey iron ingots, and recovered grey iron scrap material;

melting the scrap steel, grey iron ingots, and recovered grey iron scrap material in relative proportions to approximate the molten controlled content grey iron metal; and

adjusting the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of the approximated molten controlled content grey iron metal to the extent necessary to provide the molten controlled content grey iron metal.

3. The method of claim 1 wherein the molten controlled-content grey iron metal is alloyed with tin in a percentage dependent on an important section of the part being cast that is required to have greatest strength and/or machinability.

4. The method of claim 3 wherein the molten controlled-content grey iron metal is alloyed with tin at the high end of the percentage range for parts with an important section that cools slowly.

5. The method of claim 3 wherein the molten controlled-content grey iron metal is alloyed with tin at the low end of the percentage range for parts with an important section that cools quickly.

6. (Cancelled)

7. (Cancelled)

8. (Cancelled)

9. A method for casting internal combustion engine parts with grey cast iron, comprising the steps of:

providing a molten grey iron metal having a carbon equivalent of about 4.05%, comprised of about 3.40% to about 3.45% carbon, about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, base iron sulfur of about 0.05% to about 0.07%, manganese of about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, and base iron chromium less than about 0.10%;

alloying said molten grey iron metal prior to pouring with tin to a total tin content of about 0.05% to about 0.10% to provide a molten tin-alloyed grey iron metal;

inoculating said molten tin-alloyed grey iron metal prior to pouring with a grey iron inoculant to a further silicon addition of from about 0.10% to about 0.12%; and

casting an internal combustion engine part as soon as possible after said inoculation.

10. The method of claim 9 wherein the step of providing the molten grey iron metal comprises determining the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of scrap steel, grey iron ingots, and recovered grey iron scrap material, melting the scrap steel, grey iron ingots and recovered grey iron scrap in relative proportions to approximate the molten controlled content grey iron metal; and

adjusting the carbon, silicon, phosphorus, sulfur, manganese and chromium contents of the approximated molten controlled content grey iron metal to the extent necessary to provide the molten controlled content grey iron metal.

11. The method of claim 9 wherein the molten grey iron metal is alloyed with tin in a percentage dependent on an important section of the internal combustion engine part being cast that is required to have greatest strength and/or machinability.

12. The method of claim 11, wherein the molten grey iron metal is alloyed with tin at the high end of the percentage range for internal combustion engine parts with an important section that cools slowly.

13. The method of claim 11 wherein the molten grey iron metal is alloyed with tin at the low end of the percentage range for internal combustion engine parts with an important section that cools quickly.

14. The method of claim 9 further comprising removing the cast part from its mold while it is in excess of 1400°F.

15. A method for casting internal combustion engine parts, comprising,

preparing a molten grey iron metal for pouring that comprises a carbon equivalent of about 4.05% with about 3.40% to about 3.45% carbon and about 1.80% to about 1.90% silicon with less than about 0.03% phosphorus, base iron sulfur of about 0.05% to about 0.07%, manganese of about 1.7 times the percentage of sulfur plus about 0.30% to about 0.40%, base iron chromium less than about 0.10%, and tin of about 0.05% to about 0.10%, by the steps of transferring the molten grey iron metal, absent the tin, to a pouring ladle, adding tin to the molten grey iron metal in said pouring ladle to said content of about 0.05% to about 0.10%, and thereafter inoculating the molten grey iron metal with an inoculant to a further silicon addition of from about 0.10% to about 0.12%;

pouring the molten grey iron metal as soon as possible after said inoculation into a casting mold; and

shaking the resulting casting out of the casting mold while at a temperature over 1400° F.

16. The method of claim 15 wherein the resulting casting includes an important section that cools slowly and the molten grey iron metal, when poured, has a total tin content of about 0.10%.

17. The method of claim 15 wherein the resulting casting includes an important section that cools quickly and the molten grey iron metal, when poured, has a total tin content of about 0.05%.

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PTO/SB/17 (10-03)
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FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 500.00

Complete if Known	
Application Number	10/027,071
Filing Date	12/20/01
First Named Inventor	Joseph R. Ward
Examiner Name	Kevin P. Kerns
Art Unit	1725
Attorney Docket No.	D5216

METHOD OF PAYMENT (*check all that apply*)

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☑ Deposit Account:

Deposit Account Number: 14-0603

Deposit Account Name: International Truck & Engine

The Director is authorized to: (*check all that apply*)

☑ Charge fee(s) indicated below ☑ Credit any overpayments

☑ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, **except for the filing fee**

to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Fee ($)	Small Entity Fee Code	Fee ($)	Fee Description	Fee Paid
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($)

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20** =		X		=	
Independent Claims		- 3** =		X		=	
Multiple Dependent						=	

Large Entity Fee Code	Fee ($)	Small Entity Fee Code	Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

***or number previously paid, if greater; For Reissues, see above*

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Fee ($)	Small Entity Fee Code	Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing a brief in support of an appeal	500.00
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) ____________

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 500.00

SUBMITTED BY				(Complete (*if applicable*))	
Name (Print/Type)	Dennis Kelly Sullivan	*Registration No. (Attorney/Agent)*	26,510	*Telephone*	630-753-2311
Signature	Dennis Kelly Sullivan			*Date*	12/22/04

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